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## DEDICATION OF OBSERVATORY AT CASE SCHOOL OF APPLIED SCIENCE.

By K. O. THOMPSON.

Case School of Applied Science, Cleveland, Ohio, dedicated a new observatory on Tuesday, October 12, 1920, with the formal presentation of the keys by Mr. Worcester R. Warner, of the noted firm of Warner and Swasey, and an address by Director W. W. Campbell of the Lick Observatory. The new building was erected and equipped by the Warner and Swasey Company on a plot of land about two miles east of the campus, at the crest of the old shore-line of Lake Erie as it rises from Euclid Avenue and slopes away to the south. The distance from Euclid Avenue is about a quarter of a mile, the neighborhood being entirely residential. The building is in the center of a triangular lot, bordered by a fringe of trees on two sides and a street on the third. It will be known as the Warner and Swasey Observatory, in honor of the donors.

The plan of the building is L-shaped, with the tower for the telescope at the angle, one single-story wing containing a library and conference room, and the other housing two astronomical transits and a zenith telescope, all the products of the Warner and Swasey factory. There is also a constant temperature room containing two Riefler clocks. In the basement are living rooms for the caretaker, a storeroom, a battery room, and a dark room. The material of construction is red brick with stone trimmings. The telescope itself has a 10-inch lens, ground by John Brashear of Pittsburgh; it is fitted with all the most recent improvements and is superbly mounted.

Both Mr. Warner and Mr. Swasey spoke, the latter reviewing some of the work of the company during the last thirty years, and the former, who is a trustee of Case School of Applied Science, presenting the keys to President Charles S. Howe, who made a fitting response. The main address of the occasion by Director Campbell was upon the appropriate subject, "The Daily Influences of Astronomy". He reviewed the importance of science in civilization, and of idealism in science, to show "that we may judge of the degree of civilization of a nation by the provision which the people of the nation have made for

the study of astronomy". Since the '30's the study has steadily grown in this country. In our daily life now astronomy (1) furnishes us with accurate time; (2) determines latitude and longitude for the map makers; (3) renders navigation safe; (4) aids in the establishment of boundary lines; (5) calculates the times of tides. Beyond these elementary and yet fundamental services there lie the contribution to the scientific spirit, the understanding of man's real place in Nature, the utilization of solar energy, and knowledge of the possibilities for life on other planets. He left the question of planetary life open, at least so far as it applies to Mars and Venus; he expressed the conviction that we have nothing to fear from collision with any heavenly body. His concluding plea was for greater interest in this study which has such great practical value, and which lifts men up to higher levels of thought.

Professor D. T. Wilson of Case spoke of his hope that the new Observatory might be of community service, not merely to satisfy popular curiosity, but further to rid people's minds of superstition and narrowness.

## ERIC DOOLITTLE.

By SAMUEL G. BARTON.

Eric Doolittle, the subject of this sketch, was born in Ontario, Indiana, July 26, 1870. When his father, C. L. Doolittle, was appointed professor of mathematics and astronomy in Lehigh University in 1876 the family moved to Bethlehem, Pennsylvania. Eric Doolittle graduated there as a civil engineer in 1891. He spent the summer and the following one in practicing this profession as assistant to the city engineer of Bradford, Pennsylvania. His nature revolted against the politics sometimes connected with such positions, as anyone who knew the man can readily understand. The year 1891-2 was spent as teacher in the Bethlehem Preparatory School. He spent the next year as instructor in mathematics at Lehigh and the next two in the same capacity at the University of Iowa. During this time he was advancing his knowledge by private study. One thing which he did was to solve the problems contained in "Dynamics of a Particle" by Tait and Steele. As some of these problems required for their solution branches of mathematics which he had not studied he was led to study those branches in order to solve the problems. He stated to me that he finally solved all but about half a dozen. This was a remarkable mathematical achievment especially for one who had had only an undergraduate course. The next year was spent in graduate study in astronomy

under Professor T. J. J. See, then at the University of Chicago. He planned to take a master's degree and wrote his thesis. This thesis was so meritorious that he was advised not to present it, as it would be acceptable as a doctor's thesis. He never completed his full requirements for the doctor's degree.

In 1896 he was called upon to serve as instructor in astronomy at the University of Pennsylvania. His father had been called there in the meantime as professor of mathematics and astronomy. With the establishment of the Flower Observatory in 1896 the departments were separated, and the father became Flower Professor of astronomy and director of the Flower Observatory, to which position the son succeeded in 1912 when the father retired.

At the observatory the father devoted himself to the zenith telescope which he had obtained as a part of the observatory equipment in order to continue the investigation of the variation of latitude which he had begun at Sayre Observatory at Lehigh. The son commonly known simply as "Eric" by his friends and colleagues was placed in charge of the equatorial, a new instrument with a nearly perfect 18-inch lens made by Brashear. Later Mr. Brashear became a very close friend of Professor and Mrs. Doolittle and was frequently their guest at the observatory. When Mr. Brashear would praise the work done by Professor Doolittle an argument would ensue. He would claim the merits of the work were largely due to the splendid instrument which had been made for him while Brashear claimed that it was the man at the eye end of the telescope which was the important factor. Mr. Brashear took pride in the fact that the instrument which he had made so carefully was put to such excellent use. His interest in his instruments did not end when he received payment for them. Others will agree that both telescope and observer are very important and that it is a fortunate circumstance when a careful observer has an excellent instrument to work with. This was such a case, and results of very high order were obtained.

The focus of the instrument was made long (30 feet) for double star work. Professor Doolittle began his double star observations at once. Observation of double stars however was not the only duty of the instructor in astronomy. There were classes to be taught at the University, located in the city five miles away with poor transportation facilities. One evening each week was to be devoted to the exhausting duty of showing the wonders of the sky to large companies of visitors. So great was his enthusiasm that in addition to performing his other duties he tried to use the equatorial in nearly all clear weather, working all night and with a very short nap, if any, going to meet his class appointments. Yet he never slighted his classes as one might be tempted to do. It is related that once when a blizzard blocked the cars he exhausted himself trying to walk part way to meet his class. Had he succeeded, there would have been no class to teach.

In cloudy weather, between classes, and at other odd times, he was engaged in computing the secular perturbations of the four inner planets by the method which had been recently developed by G. W. Hill. This long piece of accurate computation was finally completed and published in 1912 by the American Philosophical Society of which he was a member.

No constitution, certainly not his, could stand such a terrific strain. His death was certainly hastened by, if it was not the direct result of, this overwork. As a result of his industry there are found in the publications of the Flower Observatory measures of 3920 double and multiple stars and the remeasurement of 648 double stars discovered by Hough. Another series of observations awaits publication. There are also many discussions of double stars and other subjects which he wrote for the various astronomical journals.

In 1913 S. W. Burnham, who had long been recognized as the world's authority upon double stars, feeling that by reason of his age he could no longer properly do the duties which he had previously performed, called Professor Doolittle to him and turned over to him his manuscripts and his library, a practically complete and priceless collection, thus placing upon his shoulders the mantle of the world's foremost double star astronomer. Burnham had published his large work "General Catalogue of Double Stars" in 1906.

Professor Doolittle has been worthy of this honor for in the safe at the Flower Observatory there is a large card catalogue known as the extension of Burnham's General Catalogue. On these cards is found practically all the information on the subject of double stars which has accumulated since the publication of Burnham's catalogue. The amount of this information is very large. This information is available to those interested. The work will be continued by Professor R. G. Aitken of the Lick Observatory, as Professor Doolittle desired, and published at some future time. Even though a considerable part of this work is clerical every detail was performed by Professor Doolittle himself, as the observatory has no clerks or computers. It was, as one double star observer expressed it, "a man killing job."

In addition to these technical works he found time to write many popular articles on astronomy. He edited and in a large part wrote Vol. IV of the "Foundation Library" entitled "The Wonderful Universe," a very interesting book on astronomy and related subjects intended for children. He has written another such book which has not yet appeared. He is widely known as the author of a series of popular monthly articles on current astronomical events which have appeared throughout the country since 1904. He was the author of a text book for the International Correspondence School, encyclopedia articles, etc.

He was very well informed upon a great range of subjects altogether unrelated to astronomy. However he seldom discussed subjects other than astronomy as one who had special knowledge. Astronomy

he discussed very enthusiastically and even one who knew nothing of the subject could perceive that he loved his subject as a true scientist should. Early in his career he was offered a very large increase in salary to take a position in engineering but he decided that he loved astronomy too much to enter another field of activity. This inspiration was not lost upon his students. All of his students and particularly those, such as graduate students, who came into close contact with him are enthusiastic in praise of him both as a scholar and as a friend.

In fiction Dickens was his favorite author. One nearly always found a volume of Dickens' works near him. It is exceedingly doubtful if there is a man who has read his works as often.

He was modest in the extreme, disliking publicity or ostentation. He was not a frequent attendant at scientific meetings, and while an interested listener he seldom partook in any public discussion. He was very polite and would not willingly offend anyone. He was absolutely unselfish, thinking of the welfare of others but not of his own. To think of him as doing anything dishonorable was impossible. Had he been of a more aggresive type his great ability would have been more widely known and appreciated. To know such a man was to love him. Those who knew him best loved him most. To have known and loved him was a rare privilege.

He was a member of the American Philosophical Society, American Astronomical Society, a Fellow of the Royal Astronomical Society, a fellow of the American Association for the Advancement of Science, a member of the Authors Club, Sigma Xi, etc.

At the beginning of the war, feeling that he wished to do something and knowing that he could not endure the hardships involved in most branches of the service, he spent much time studying to be a wireless operator as he had read that such operators were badly needed. Later he was called upon to organize and conduct the U. S. Shipping Board Navigation School at Philadelphia. In attempting to teach the large number of men suddenly thrust upon him as well as to attend to the correspondence, registration, and a lot of other burdensome details in hot weather without assistance, as none had been provided, he greatly overtaxed his strength and collapsed under a slight stroke. Although he recovered partly and performed his regular duties at the University in the fall he never fully recovered and did but little observing thereafter. In May this year he was taken ill again and when his condition seemed serious he was removed to the University Hospital on June 24.

In 1902 he was married to Sara Halliwell who survives him. The marriage was a most happy one. She was in full sympathy with his ideals and aspirations and willingly endured the great sacrifices which she was required to make. She was in constant attendance upon him while at the hospital. While walking on the observatory grounds on September 2, thinking of him, she made a misstep and had the great misfortune to break her leg above the ankle. She was removed to the

hospital and could only be brought to his bedside occasionally in a wheel chair.

Realizing his condition he said that if he were going to die he wished that it might be there in the shadow of College Hall in which he had taught for 25 years. He died on September 21. In accordance with his wishes he was buried at Bethlehem with an extremely simple service attended only by the family and a few very intimate friends. A public memorial service for him under the auspices of the University of Pennsylvania will be held November 12.

## DEFINITION AND RESOLUTION.

By WILLIAM H. PICKERING.

These two terms when used astronomically are often confused. The resolving power of a telescope may be defined as its power to separate small close objects where there is great contrast with the background, as in the case of a close double star. The defining power depends on its power to separate or distinguish somewhat coarser objects where the contrast is much less, as in the case of planetary and lunar detail away from the terminator. Both depend on the aperture and the seeing, but the resolution depends chiefly on the former, and the definition chiefly on the latter. With small apertures and excellent seeing the resolution varies directly as the aperture. With larger apertures and inferior seeing the gain is not so great, and with poor seeing may, according to Professor Aitken, be reduced to zero. In the case of the definition on the other hand, instead of a gain there is sometimes even a loss with increased aperture.

For numbers 5 and 6 on the Standard Scale of Seeing, which has now been adopted by nearly all planetary observers, the best aperture is eight inches. For very poor seeing, 2 and 3, the best aperture is probably five. As we do not have any very poor seeing in Jamaica, this size is a little uncertain. For seeing better than 6 we have not been able to determine the proper aperture, because our own is only eleven inches, and a larger aperture would doubtless give better results. In Arizona however the late Dr. Lowell found that twelve to eighteen inches was usually the best, but as he did not record the seeing, that does not help us much (Lowell Bulletin No. 59). Similar results have been obtained by Phillips and Jarry-Desloges.

When Harvard occupied Mount Wilson in 1890, before the present observatory was built, we found the seeing there excellent, but it was feared that it would be hardly good enough to stand so large an aperture as 100 inches for planetary definition. I was therefore much

pleased to see by the April number of the *Publications of the Astronomical Society of the Pacific,* p. 114, that with the new telescope Dr. Hale had been able to separate the double canal within the lunar crater Aristillus.* This is indeed a triumph for both the telescope, and for the seeing at Mount Wilson. At only three other observatories has it been found possible to detect the separation, and we are glad to welcome that at Mount Wilson into this somewhat exclusive circle.

As has been previously fully described in this magazine, the two canals vary with the colongitude from 300 to 1500 feet in width, and are 24 miles in length, or 80 times their maximum breadth. We may picture them to ourselves as two narrow, dark, slightly diverging bands one-eighth of an inch wide at maximum, and ten inches long. With our aperture they appear perfectly straight, uniform, and tapering, save that the southern one has a slight bend to the south where it crosses the rim of the crater. They cannot be cracks, since they are invisible under a low sun. They gradually broaden and darken towards noon. They therefore must be surface markings, and unless we can conceive of them as being artificial, it is highly improbable that they should really be and should be maintained, straight and uniform for so great a distance over such a rough country. They cross two or three cracks in their course, but apparently suffer no alteration as a result.

Just within the crater rim the canals cross what appear to be two minute and very difficult lakes. These were discovered here recently at colongitude 57°, and may eventually prove to be merely shadows, but they are far more difficult than the canals themselves. Indeed the duplication of the canals inside the crater, although invisible at most of the world's observatories, can hardly be considered a test for seeing in Jamaica. It is believed that they can be separated here on half of the clear nights when they should be visible, throughout the year. If with the 100-inch telescope the Mount Wilson observers can detect and depict, or describe, any other irregularities in the first twelve miles of their outline, to where they throw out side branches, that will be more than any other observatory has been able to do up to date, and will indicate that the 100-inch has not only equal, but superior definition to any other. If they cannot detect any irregularity that fact in itself will be of interest.

But superior defining power is by no means the only requisite demanded for advanced planetary research. Lunar or planetary investigations which do not detect change of some sort are of but little consequence at the present day. To detect and prove the existence of change requires many hours of careful observation under the most favorable conditions. Moreover these observations should be made if practicable on successive nights. A mere glance through a telescope proves nothing.

For successful planetary research therefore we require many nights

*Popular Astronomy 1914, **22**, 570; 1916, **24**, 273 and 575.

in a year of the best obtainable definition. The larger the aperture the fewer the nights when it can be used to advantage. The larger aperture gives definition, the small aperture gives many useful nights. There is therefore a medium aperture which gives the best results. Of course a large aperture can always be stopped down with a diaphragm, but one does not wish to spend money on a large and clumsy telescope which can only be used occasionally with its full aperture. On the other hand there is an enormous amount of useful work for a very large telescope to do in the stellar system, where good definition is of less importance, and the full aperture can be employed to advantage. Hence it happens that large apertures even if favorably situated, are not adapted to planetary research, and are never now-a-days used for that purpose.

Although the double canal within Aristillus is striking in appearance, and well suited as we have seen for a test object, yet there are plenty of other objects much more difficult, some of which have already been suggested to Dr. Hale, and which I hope he will have the opportunity to examine,—not on account of the objects themselves, but as a test for his instrument. One of the most convenient is the little group of canals near the double one in Aristillus, drawn at colongitude 50°, and represented in POPULAR ASTRONOMY for May, 1916. The same region, as seen at the Lowell Observatory, is shown in the February number for the same year. Another good test is the straight narrow bright line paralleling the upper reaches of the Mt. Hadley river bed, connected with it at both ends, and looking much as an artificial canal would upon the Earth. Its breadth cannot be greater than 50 yards, and its length 5 miles. It is visible with good seeing at colongitude 43° to 57°. Another test although not so difficult perhaps as some of the others, is the detection of the elliptical disks of Jupiter's satellites numbers II and IV. I and II are so easy that they can hardly serve as test objects at those observatories capable of resolving the Aristillus canal, but II and IV are distinctly more difficult than the others.

A very delicate test, even when it happens to be well placed for observation, is the little lake and its five canals situated within Elysium, on Mars. These were discovered by the late Dr. Lowell, who considered them so difficult and unique as to justify him in describing them as a new Martian phenomenon (POPULAR ASTRONOMY 1916, **24**, 321). The lake and three of these canals have been confirmed here recently on two occasions. A single drawing of Mars in one of the six standard longitudes, made at the next apparition, would give a very fair test of what the 100-inch telescope can do, as compared with the work of the most expert planetary observers of the present day, using smaller telescopes. Such a drawing would require hardly more time than an hour, including that needed to exchange an eye-piece for a plate holder, and consequently need not interfere more than might a passing cloud with the regular work of the instrument. Accurate

location of the detail would not be necessary, so that a practised observer would not be needed. Any man with keen eye-sight would serve, whether he had ever looked at Mars through a telescope before, or not. Such a test would I believe be of interest to the observers themselves, as well as to other astronomers and the general public.

It is hoped that some of these suggested tests will be of use to the Mt. Wilson observers. While it may be said that the great reflector has now very creditably passed its preliminary test, as giving excellent planetary definition, it must do something more than resolve the Aristillus canal before we can accord it superiority in that department of astronomy, to the three or four observatories now specializing on lunar and planetary detail.

Mandeville, Jamaica, B. W. I., July 30, 1920.

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## TWENTY-FOURTH MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

*(Continued from page 445.)*

### ABSTRACTS OF PAPERS

#### THE SPECTRA OF SOME VARIABLE STARS.

By W. S. Adams and A. H. Joy.

Considerable interest attaches to the character of the spectrum of the stars usually classed as Algol variables of very long period. Four such stars have been observed by us at Mount Wilson with the 100-inch and 60-inch reflectors. They are as follows:

1. SX Cassiopeiae. Magnitude 8.6 — 9.7, Period 36.5 days.
The spectrum resembles that of $\alpha$ Cygni in the intensity and character of the enhanced lines. The $\beta$ line of hydrogen is doubly reversed with a dark central component accompanied by a bright line on either side, and H$\gamma$ probably has bright fringes as well. These bright lines appear to vary in intensity with the phase of he star's light. Measurements show a considerable range in radial velocity. Spectrum A5p.

2. RX Cassiopeiae. Magnitude 8.6 — 9.1, Period 32.3 days.
The spectrum is similar to that of W Serpentis usually classed as a Cepheid variable. H$\delta$, H$\gamma$, and H$\beta$ are double bright lines with a dark center, and the characteristics of the Cepheid spectrum are shown in the intensity of the enhanced lines. Spectrum G3p.

3. TT Ophiuchi. Magnitude 8.9 — 11.0, Period 61 days.
This spectrum is similar to that of SX Cassiopeiae in its resemblance

to α Cygni, but the spectral type is considerably more advanced. The hydrogen lines Hγ and Hβ are fairly narrow, prominent, bright lines and vary greatly with the phase of light. A moderate variation occurs in the radial velocity. Spectrum F5p.

4. RZ Ophiuchi. Magnitude 9.7 — 10.6, Period 262 days.
The spectrum resembles that of the Cepheid variables in the intensity of the enhanced lines. Hβ is bright and so wide that higher dispersion might perhaps show it double. Hγ is a strong absorption line. Spectrum G2p.

All four of the stars investigated, accordingly, show one or more bright hydrogen lines, and this fact may have considerable importance in its bearing on the character of the light variation. The marked resemblance of these spectra to those of the Cepheid variables is also of interest.

Two other variable stars which have been observed recently show spectra which are deserving of comment.

1. RT Scuti. Magnitude 9.1 — 9.7, Period 0.5 day.
This is classed as a short-period Cepheid variable. The spectrum is of type Ma and the star evidently belongs to the giant class. A spectrum of this type is entirely abnormal for Cepheids of short period which belong regularly to types A and early F.

2. 7-1917 Serpentis. Magnitude about 10.
This star is the variable or new star first discovered by Wolf and later independently by Barnard. The spectrum shows a bright Hβ line and a few lines characteristic of spectral type about F0. Little detail is shown in it and the intensity of the continuous spectrum appears to fall off more rapidly than would be expected toward the violet.

## NOTE ON THE SPECTRUM OF T PYXIDIS.

By W. S. Adams and A. H. Joy.

Spectroscopic observations of the irregular variable star T Pyxidis made near the maximum of light in April of this year show numerous interesting relationships to the spectrum of novae and necessitate a revision of some of the hypotheses advanced to account for the origin of temporary stars. This maximum was the third in thirty years and the form of the light-curve and the characteristics of the spectrum were announced by the Harvard observers to be very comparable with those found in novae.

The southern declination of the star, —32°, makes it difficult of

observation, but three photographs of the spectrum were obtained with the 100-inch reflector on the nights of April 11, 27, and 30, 1920. The characteristics of the nova spectrum are very marked. Bright bands are present in the positions of the hydrogen lines, about 25 angstroms wide and varying in width in direct proportion to wave-length. Accompanying these bands on the violet side are very strong dark bands broken up into several components. A number of fainter emission bands are present, most of which may be identified with enhanced lines of iron and other elements, and several diffuse absorption lines in the vicinty of λ 4600 are without doubt due to oxygen and nitrogen. The spectrum is very similar to that of Nova Aquilae of 1918 about ten days after its discovery and practically identical with that of the Nova in Lyra discovered by Miss Mackie and photographed with a spectrograph on the 100-inch telescope on February 4. The stage in the development of the spectra of novae when oxygen and nitrogen lines appear seems to be an intermediate one and has been the subject of discussion by the English astronomers, Stratton and Baxendall.

The displacement of the absorption lines as measured in the spectrum of T Pyxidis on April 11 was —22.7 angstroms. On April 27 and April 30 this had increased to —28.1, the values being based upon 13 lines due to hydrogen, oxygen, nitrogen, and other elements. The change of 5.4 angstroms in the interval of 16 days is suggestive of the similar increase in the displacement of the lines in the spectrum of Nova Aquilae of 1918 during the period following its discovery. The value found for the later dates is almost exactly the same as that of the corresponding lines in Nova Lyrae, which is —28.4 angstroms. In all cases the displacement is proportional to wave-length and the quantities given are reduced to λ 4600.

Reference has been made to the multiple components of the hydrogen absorption lines. Measurements of the displacements of the three principal components on the photographs of April 27-30 give the values —28.1, —21.3, and —14.4 angstroms. A fourth faint component gives —7.2 angstroms. The close agreement of these quantities with the ratios 4, 3, 2, and 1 is remarkable. A somewhat simlar relationship was found in the case of Nova Lyrae, except that the second component could not be measured. The results were —28, —15, and —8 angstroms. Attention has been called previously to corresponding simple ratios among the displacements of the absorption lines in Nova Aquilae of 1918 and other novae, and the subject is of marked interest as bearing on the nature of the radiation and absorption bands in these stars.

In view of the close agreement of the spectrum of T Pyxidis with that of novae it seems probable that a comparison with the spectra of certain stars of early type with bright lines such as P Cygni and β Lyrae might yield results tending to establish a relationship with these remarkable objects.

## PERSONALITY IN THE ESTIMATION OF TENTHS.

By Sebastian Albrecht.

This report completes the investigation for which a preliminary statement was given at the meeting in 1918. The results obtained should find application in the design of setting and measuring scales in general. The factors conducive to speed of measurement are naturally more or less in conflict with those most favorable to the greatest accuracy. Usually speed of measurement is an important element in our problems, so that it is worth while to give sufficient thought in the design of our scale to obtain an efficient balance betweeen these conflicting factors. For any particular instrument or purpose we want, for example, to have the scale subdivided enough, and not more than enough, to give the accuracy which is readily attainable with whatever speed of measurement is essential to the successful prosecution and completion of the problem. That this is not always attained in the instruments with which we work is shown, for example, by statements to the effect that such a high degree of accuracy is attained that the second settings almost invariably duplicate the first settings. However, it is readily apparent that when this obtains the measures contain two inherent defects, namely, the readings are not being taken with the degree of accuracy justified by the accuracy of the settings, (i. e., the second settings are largely superfluous and therefore wasted effort), and the individual means of two settings contain the peculiarities of the personal scale of the measurer to nearly their full extent. The nature of these peculiarities were studied in considerable detail. Personal scales were available for twenty-three different observers, covering various periods of time, in one case 39 years. Special scales with rulings ranging in width from 0.02 to 0.60 of the scale-interval were also employed. Among the more general results it was found that personality in the estimation of tenths is a very definite thing, so that it is perfectly feasible to determine and apply corrections to measures for this cause of inaccuracy. It was established that the epoch is the important consideration in discussing a personal scale, and not change of location or of instrument (similar in kind).

An individual personal scale may vary, but the variation is gradual and generally progressive. It is essentially constant during short periods of time, such as a few months or less. Fatigue during a protracted continuous period of observing (five hours) produced no appreciable change. The zero-tenth is almost universally favored, and not any tenth is as generally neglected as the zero is favored. Most of the curves representing personal scales are essentially symmetrical with respect to 0.0 and 0.5. Most observers have a definite tendency to estimate an index too close to the nearer of the two adjacent scale-rulings. This tendency varies quantitatively with the widths of the lines. When the 0.5 positions on the scales are also marked by (short)

graduations the problem becomes essentially that of estimating fifths. Among the most gratifying results obtained is the indication that observers without previous practice in the estimation of tenths can acquire and retain a nearly true scale of tenths with only a very small amount of drill with practice scales. On account of the influence which the widths of the lines have upon the estimations practice scales should always be similar to the scales employed in the regular work in respect to the widths of lines and (apparent) scale interval.

## OBSERVATIONS OF VARIABLE STARS AT THE McCORMICK OBSERVATORY.

By Harold L. Alden.

The observation of long period variable stars with the twenty-six inch McCormick telescope was first begun about 1903 and continued until 1912. During that period about four thousand observations were made on one hundred and twenty-five variables, chosen mainly from Hagen's Atlas.

In 1915 the observations were resumed during the midnight hours, eighty-three of the fields previously observed being retained on the observing list. One hundred and four stars have been added, making a total of one hundred and eighty-seven stars under observation. Most of these stars are fainter than magnitude thirteen at minimum. Over six thousand additional observations have been made to date.

Since the faintest star visible in the McCormick telescope is about the sixteenth magnitude and care is taken to observe only those stars which are faint, the observations should form a valuable contribution to our knowledge of the variations of these stars at and near minimum when beyond the reach of observers with telescopes of moderate aperture.

The reduction of the observations must await the determination of the magnitudes of the faint comparison stars used. To establish the scale a wedge photometer is employed. The zero point is obtained by measuring the faintest stars which have had their magnitudes photometrically determined at the Harvard College Observatory. Grade estimates of all the stars used are adjusted graphically to the photometer scale and the mean of the photometric and visual magnitudes adopted as the final magnitude for each comparison star.

About twenty-five per cent of the stars under observation have been completely reduced. It is hoped that the results can soon be published in whole or in part so that the data will be available.

## PARALLAX DETERMINATIONS OF BRIGHT STARS.

By Harold L. Alden and S. A. Mitchell.

Accurate parallaxes of the bright stars are very much to be desired. The principal difficulty encountered in the application of the photo-

graphic method is due to guiding error. To eliminate this the image of the parallax star must be of the same size as the images of the comparison stars used.

The single rotating sector with very small slit and the double rotating sector have been found unsatisfactory as the short and intermittent exposures do not eliminate the guiding error even though the images do fulfill the above condition.

The device in use at the McCormick Observatory at present consists of a very thin, neutral-tinted gelatine screen absorbing five magnitudes. This is the same size as the single rotating sector and is used in combination with it, giving a reduction in brightness as great as twelve magnitudes, if necessary. This screen is permanently cemented to the center of a visual-luminosity filter such as is always used for photographic work with the McCormick telescope and this filter is placed in a separate plate-holder reserved for use with the brighter stars.

Plates have been taken on most of the first-magnitude stars available at our latitude and measures of these plates seem to indicate that the effect of guiding error has been effectively reduced. It is certain that the parallaxes of the bright stars can be obtained with an accuracy equal to that for fainter stars, namely with probable errors less than a hundredth of a second of arc.

## VARIABLE STARS IN MESSIER 22.

By S. I. Bailey.

Messier 22 is one of the finest of the globular clusters. An examination of 1550 of the brighter stars at Arequipa, about a quarter of a century ago, gave sixteen variables. The majority of these have a period of about two-thirds of a day. Two exceptions occur, No. 3, with a period of about one-third of a day, and No. 14, with a period of 199.5 days. No. 14, on account of its long period and large range of variation, was at first assumed to be an ordinary long-period variable. When the observations were plotted, however, the light-curve appeared to be that of the cluster type. In *Harvard Circular* 173, Miss Leavitt announced the discovery that for twenty-five stars in the Small Magellanic Cloud a definite relation existed between magnitudes and periods. In *Harvard Annals*, **78**, Part 3, the writer showed that in general this law is not applicable to the small difference in periods which occur in the globular clusers. In Messier 3 and 5, and $\omega$ Centauri, however, are seven stars of longer periods, which may be regarded as of Cepheid type. Among these there is a tendency to follow the law but in most cases with large deviations. No. 14 in Messier 22, if really a member of the cluster and of Cepheid type, would furnish a striking exception to the law, since not only is the period very long but the brightness is

about a magnitude less than other variables in the cluster. The exact form of the light-curve at minimum is somewhat in doubt. Additional photographs are needed and will be secured to determine the truth with certainty.

## CONCERNING RESULTS OF OBSERVED GRAVITATIONAL LIGHT DEFLECTIONS.

By Louis A. Bauer.

The results of the light deflections observed by the British Expedition at Sobral, Brazil, during the total solar eclipse of May 29, 1919, as derived from Crommelin's seven photographic plates, using a 4-inch lens of 19-foot focus and an 8-inch coelostat, gave a deflection at the sun's limb of 1".98, or about 14 per cent higher than the value (1".74) derived from the Einstein theory of gravitation. Resolving the published deflections in right ascension and declination, for each of the seven stars concerned, into two components, one along the radius vector to the center of the sun, the *radial component*, and the other transverse to the radius vector, the *non-radial component*, it was noted independently by Dr. Silberstein and the author that the observed total deflections were not strictly radial, the non-radial components being of appreciable magnitudes and varying in a strikingly systematic manner from star to star. The observed deflection appeared to be a function not simply of distance alone, as required by the Einstein law, but also of the star's position angle.

With the view of determining the possible bearing upon the observed light deflections of the geophysical observations made by the expeditions of the Carnegie Department of Terrestrial Magnetism at Sobral, Brazil, and Cape Palmas, Liberia, and by the Brazilian expedition at Sobral, an analysis was undertaken by the Department of Terrestrial Magnetism. It may be recalled that the question was raised and discussed in *Nature*, by various British investigators, whether there might not be appreciable abnormal refraction effects in the earth's atmosphere as caused by meteorological changes during totality.

A first analysis, made before the publication of the British observations in detail, indicated that the anomalous effects in the light deflections, referred to in the first paragraph, might possibly be explained by incomplete elimination, from one cause or another, of differential terrestrial refraction effects. For example, the non-radial components were found to be proportional to the differences in the differential refraction effects between the times of exposure of the eclipse plates (May 29) and the comparison plates (July 14-18). The radial components likewise seemed to show some connection with these refraction differences.

Upon submitting the results of our investigation to the Astronomer

Royal, Sir Frank W. Dyson, we were courteously furnished with some additional information, as well as an advance copy of the printed British report. We thus were enabled to make an independent reduction by two different methods of the photographic measures resulting from Crommelin's plates. It was necessary to adopt the British computed differential-refraction corrections as the published information was insufficient to enable either my chief assistant, Mr. W. J. Peters, or Dr. Frederick Slocum, who was connected with the Department of Terrestrial Magnetism as Research Associate during the present summer, to make a rigorous, independent computation. We must, accordingly, await further information from the Astronomer Royal before being able to decide definitely whether there are any appreciable differential refraction effects in the published light deflections. As far as we could proceed, however, it would appear that some of the anomalies in the published light deflections result from the method of deriving the published deflections for the individual stars *after* the least square adjustments of the photographic measures were made, regarding which we are awaiting further information from the Astronomer Royal.

The non-radial components, as found from both of our methods of reduction, are on the average about one-third of those derived from the British published results; in brief, they are on the order of the error of observation, about $\pm 0''.04$, and thus may be regarded as non-existent. Respecting the radial components of the light deflections, some improvement has also resulted from our reductions. Thus star 11, the most distant star, according to the British reductions, showed a deflection agreeing better with that computed on the basis of the Newtonian mechanics, whereas we obtain a value agreeing better with the Einstein one. However, we have made no alteration in the general result of the Crommelin plates, namely, that the deflection at unit distance, or at the sun's limb, is about 14 or 16 per cent greater than according to the Einstein theory.

Whether the high result is to be ascribed to the instrumental means which had to be employed or is indicative of the possibility that the observed light deflections were a combined effect of the sun's gravitational action and of a solar atmospheric action of some kind is a question which will doubtless have to be left to the future for settlement. It is somewhat unfortunate for this purpose, as well as for the accurate testing of the Einstein law of variation with distance, that the quantity sought, the physical light deflection, is not directly observed but must be determined by a least square adjustment from a more or less limited set of observation-equations involving three or more other unkowns —the plate-constants. The deflections as finally obtained for the individual stars are thus the products, partly of observation and partly of adjustment. They may hence contain spurious extraneous effects, varying in magnitude and run according to the method of adjustment adopted by the computer. In our second method of reduction, we, ac-

cordingly, determined the plate-constants from the four fairly uniformly distributed stars (Nos. 2, 5, 10, and 11) for which the Einstein term was smallest; with the constants thus obtained the light deflections for the seven stars were derived. The resulting deflections for the three stars (Nos. 3, 4, and 6), not entering into the adjustment equations from which the plate-constants were found, satisfied the Einstein law, in general, fairly well; the deflections were, however, all larger than the Einstein value. In our first method, the plate-constants and the value of the light deflection at unit distance were simultaneously determined from a least-square adjustment, using all seven stars; the same was done in the British reduction.

Final conclusions must be deferred until the additional requisite information has been received.

## GHOSTS AND OCULARS.

By Louis Bell.

Since the visibility of celestial objects depends on their contrast with the background of the field, stray light in that field is of consequence whether it comes from an extended area external to the field or from light reflected from optical or other surfaces. Of the light normally incident on a refracting system of $n$ surfaces, for unity incident light $1-(1-k)^n$ is the reflected component, where $k=(\mu-\mu')^2/(\mu+\mu')$ Practically $k=0.05$, approximately, and the total reflected light in lens systems ranges from about 10 per cent in a single lens up to 40 per cent or more in systems having four or five separated lenses. The four lens case corresponds to the usual photographic doublets (uncemented) and to astronomical telescopes with the common positive or negative oculars, the five lens to a few photographic lenses and to terrestrial telescopes and prism binoculars.

The total reflected light is divided into reflections of odd and even series according to the number of reflections. In the first order, odd series, there are $n$ reflections; in the second order, even series, $n(n-1)/2$ reflections. Ghosts of higher order than the second, having coefficients in $k^3$ or higher powers may be neglected, as also ghosts from cemented surfaces. First order reflections are toward the incident ray and cause trouble only by reflection from other surfaces; second order reflections are along the incident ray and may be directly visible.

The total reflected light is divided between first and second orders in the proportion $k : k^2$.

Since approximately half the light lost in a telescope is lost in the ocular and scattered close to the eye it is to the ocular that one must look for improved visibility after the ghost due to reflection between the third and second objective surfaces has been taken care of by making $\rho_2 - \rho_3$ sufficient to put the ghost well out of focus.

Among oculars all the single lenses, simple, or cemented combinations, are fairly free of reflections, and the achromatic triplets give admirable fields for most purposes and unexceptionable definition, also good eye distance. Oculars of Ramsden or Kellner type give strong internal reflections especially from a second order ghost from the field lens, the more nearly in focus as the separation of the lenses nears the focal length of the eye lens. An exception is the orthoscopic type of Zeiss and Steinheil, where the separation is very small and the field lens a triplet of relatively long focus.

Huyghenian eye-pieces show no concentrated ghosts but scatter the reflections over field and mount, the field lens ghost being well out of focus. The least brightening of the field is given by the solid Tolles form, in which there are but two surfaces and these so strongly curved as to diffuse their reflections very widely. In other particulars this solid ocular compares very favorably with others of Huyghenian type. Finally there is a good opportunity for using the compensating form of Huyghenian, sometimes used in microscopes. This has a field lens of high refractive index which acts to pull down the over-correction of the objective for high powers. Actual trial with small objectives shows distinct improvement of the color correction, the tint of the focussed star-disc being in large measure free from the blue flare.

## ON TELEGRAPHING THE POSITION OF A CELESTIAL OBJECT.

By Ernest Clare Bower.

As a result of some observational experience, two suggestions in the telegraphing of the position of a celestial object are offered for consideration:

First, the space allotted to "brightness" could be more fully utilized.

| | |
|---|---|
| Let $0 = 6^m$ or brighter | $5 = 11^m$ |
| $1 = 7^m$ | $6 = 12^m$ |
| $2 = 8^m$ | $7 = 13^m$ |
| $3 = 9^m$ | $8 = 14^m$ |
| $4 = 10^m$ | $9 = 15^m$ or fainter. |

For finding purposes there is no essential difference between "naked eye" and "conspicuous"; hence, objects, $6^m$ or brighter, have been grouped together.

To make an error of one magnitude will give the searcher for the object a better idea of its brightness than the current, somewhat indefinite, designations, especially that of "large telescope". When an object of $11^m$ or fainter is assigned to brightness 5, this gives a range of 4 and 5 magnitudes for "large telescopes" like the Washington, Lick, and Yerkes. To know very closely the magnitude of the body is often of material assistance to the observer in finding it.

An observer, as an aid to other observers, often states the magnitude

anyway. This increases the message by two words, which it would seem desirable to save, especially in cablegrams.

Second, if the discovery observation made on a continent was distributed directly to all other observatories on that continent, they would receive the observation sooner by the travel time from the discovering observatory to the usual distributing observatory. This arrangement very frequently would permit observations of the object one day sooner, at least in North America. Occasions arise where this saving of travel time may become important. The cost in an individual case would be different from what it is now, but would probably average the same in the long run.

## NOTES ON THE CLASSIFICATION OF LONG PERIOD VARIABLES.

By Leon Campbell.

An attempt is here made to classify the long period variables by graphical methods. First, mean light-curves were derived for each variable from the combination of ten day mean points, referring each observed light-curve to a carefully determined date of maximum, or minimum, if the latter seemed better defined. Second, all the mean curves were reduced to equal amplitude and period, in order to simplify the comparison.

All the curves which were found to coincide were combined into a mean curve, and this procedure indicated a series of curves ranging from those with very wide maxima and narrow minima to those of wide minima and steep, narrow maxima. This showed too many types, with not enough distinction between them. Accordingly the breadth of maximum compared with that of minimum for each star seemed to serve as a means of classification, and when so determined, indicated divisions into seven groups, some more clearly defined than others, especially near the beginning and end of the series.

Here again, all the curves which appeared to fall in the same group were combined into mean curves, which showed clearly on a diagram how the series progressed. Using these seven curves as standards, it was found that nearly all of the stars discussed could be made to coincide with some one of the curves with very little uncertainty.

It is worthy of note that while the method used by Phillips differed radically from that here used, all but four of the stars in his group I fall into the first three types here indicated, and all of his group II stars fall into types 4 to 7. All of the stars of Phillips' group I, except the four mentioned, fall on, or above, a sine curve and all of his group II, below. Curve 3 represents very closely a sine curve.

The plot of the mean period for each type indicates a steady progression of increasing period with type from 2 to 7, but type 1, which would agree well with a mean period of about 200 days, has the longest period of all, 378 days. This suggests that this type (I) may be

peculiar among long period variables. This type usually presents an irregular form of curve at maximum and in a few cases, shows a well marked secondary maximum.

There appears to be a general tendency for increase in range to be associated with increase in period and type. Assuming that all of the stars in types 1 to 3 would fall into Phillips' group I, and the remainder in his group II, we have, of the 124 stars so far discussed, 40 in the first group and 84 in the second.

If, as has been suggested, some of the stars of long period may pass from one group to the other, it would seem that not only must the period be subject to a gradual change, as is noted in R Hydrae, but also the form of the curve should change.

The question of changing periods is an interesting one and considerable material is at hand for a discussion of this feature. We do know that in many cases the periods are far from uniform, and in some instances the changes are abrupt, while in others they are gradual and, for a time at least, follow definite laws.

## NOTES ON CHANGES IN THE SPECTRUM $\eta$ CARINAE.

By Annie J. Cannon.

When we consider the numerous and varied forms of the light-curves of new stars, we may be justified in placing this remarkable object in the list of novae. The spectrum has been studied on twenty-four photographs taken at Arequipa with the 13-inch Boyden telescope, between 1892 and 1916. The photographs of 1892 and 1893 show a large number of narrow dark lines which are not visible on plates taken in 1895 and later. Many of these lines agree in position and intensity with the enhanced lines of iron and other metals present in the spectra of $\epsilon$ Aurigae, *b* Velorum, and similar objects. Bright bands are inconspicuous, except those of hydrogen and the unknown band at 4359. Numerous other bright bands appear on all the photographs of this spectrum taken since 1894, and, as has been frequently stated, resemble the bright bands of Nova Aurigae.

Unpublished photographic observations of the brightness of $\eta$ Carinae made by Miss Leavitt show that the light was nearly constant at the magnitude 7.6 from 1889 until the autumn of 1894. The photographs of the spectrum showing the narrow dark lines were obtained during this period. The light of the star then decreased until in May, 1895, the magnitude was 8.3, and has remained nearly constant up to the present time. Since the dark lines are not present on any of the photographs taken at Arequipa since 1894, and are not visible on the photographs of Sir David Gill, taken in 1901, of Moore and Sanford, in 1912 and 1913, nor of Lunt, in 1919, it appears certain that a marked change occurred in this spectrum at the time of the decline in brightness in 1894 and 1895.

## A PROBABLE FACTOR IN THE WIDENING AND INCREASE IN WAVE-LENGTHS OF THE SPECTRUM LINES NEAR THE LIMB OF THE SUN.

By Ralph E. De Lury.

In connection with the discussion some years ago, of the effects of a blended spectrum in reducing differentially the measurements of the displacements of the limb spectrum lines, an hypothesis was suggested to account for the widening and weakening of the weaker spectrum lines at the limb of the sun. This hypothesis assumed that the pores of the sun were similar to sun-spots as regards convection from their centres out along the surface of the sun, and that in taking a spectrum of the limb both components of motion in the pore were blended in the spectrum lines. Now, if we assume that for the pore as for the spot the component away from the observer is larger than the component towards the observer (possibly due to a depressed centre in the case of the pore as in the case of the spot), then the wave-lengths at the limb will be greater for those lines which show outward motions in the sun-spot. Moreover, the effect would diminish gradually from the limb inward as is found to be the case, as pointed out by Evershed, who also pointed out that if pressure were the cause of the greater wave-lengths at the limb as suggested by Halm, the effect would diminish rapidly inward from the limb.

In testing the hypothesis it will be necessary to make comparisons with the wave-lengths in arc spectra as well as in spectra from the centre of the solar disc because in the latter there may be effects due to convections normal to the solar surface which would no doubt vary with the character of the spectrum line. If the assumed condition exists the conclusions as to the presence of the Einstein effect for solar wave-lengths would be modified, and the search for this effect would seem most promising for those lines which show no radial velocities in sun-spots and presumably none in pores as well.

The assumed condition in pores would cause accidental variations in the measurements of the solar rotation and differences due to different lines, but systemaic differences for lines of different intensity (determined at any latitude from west limb minus east limb) would not result unless the axis of the pore at that latitude had a systematic inclination to the normal to the solar surface, a condition which would result if there were systematic transferences of matter from level to level within the pores, or if the pores, like the spots, were magnets. (It may be noted that some measurements show systematic differences between the wave-lengths at the two poles of the sun.)

Measurements are in progress of the gradual changes in wave-length, width and asymmetry of the spectrum lines in passing from centre to limb, and systematic differences depending on intensity are being found, but the interpretation is exceedingly difficult in view of

the fact that several systematic effects are present. However, at the present time it seems that the pore effect which has been assumed may really be a factor in solar spectroscopic investigations.

## THE CONSTANCY OF THE SOLAR WAVE-LENGTHS AND THE POSSIBILITY OF DETERMINING THE SOLAR DISTANCE THEREFROM.

By Ralph E. De Lury and H. R. Kingston.

In order to test the constancy of solar wave-lengths (which like those of other variable stars might be expected to show variation possibly synchronizing with the variations in brightness such as occur during a spot cycle) it was proposed a decade ago, to keep a record of the spectrum of the sun from selected points of the disc along with some easily reproduced comparison spectrum such as the absorption spectrum of chlorine or iodine or other suitable gas. Three years later an iodine comparison spectrum was adopted (the pressure in the iodine tube being now kept automatically at 250 mm by oil pump and electrically controlled leak) and the suggestion was made that in addition to keeping a check on the solar wave-lengths a fair value of the solar distance might be obtained from the pulse in the wave-lengths caused by the approach to and recession from the sun of the earth in its eccentric orbit, the range in speed being $2V\epsilon$, that is, twice the average orbital velocity into the eccentricity, a quantity proportional to the average distance of the sun and having a value about 1 km per sec. The advantages of the method are that a great quantity of observational material is easily obtained and a very high dispersion may be used. The observations may be carried on for a number of years and compared with the theoretical values throughout each year.

Preliminary measurements indicated that a great many observations would be necessary to make a fair test of the method. Photographic records have been kept during the last six years and when these observations are measured in connection with other problems the value of the solar distance will appear as a by-product. In the meantime the following plates have been measured one way using the six solar lines (from λ5586.991 to 5590.343) on the centre spectrum and three iodine lines on two strips of spectrum (the three sharp lines near λ5588.985), two settings each line, for the purpose of testing the possibilities of the method. Measurements were made by K and D, but time did not permit K to measure the autumn series also, and owing to the systematic differences which are likely to be present in the measurements, those of D are alone used for the determination. The differences between the averages of the three iodine lines and the six solar lines are given in km per sec., the quantities being corrected for the earth's daily rotational velocity in Column I, and for the orbital velocity (including the moon's effect) in Column II. Each plate had

7 consecutive 1 minute exposures, except that of March 29 which had 6 exposures.

| Date, 1916 | K | | D | | | D | |
|---|---|---|---|---|---|---|---|
| | I | II | I | II | | I | II |
| March 23, | 11.318 | 11.818 | 11.284 | 11.784 | October 7, | 12.180 | 11.671 |
| March 23, | 11.289 | 11.789 | 11.398 | 11.898 | October 7, | 12.314 | 11.805 |
| March 23, | 11.348 | 11.848 | 11.296 | 11.796 | October 7, | 12.170 | 11.661 |
| March 24, | 11.376 | 11.878 | 11.384 | 11.886 | October 12, | 12.418 | 11.925 |
| March 24, | 11.350 | 11.852 | 11.241 | 11.743 | October 13, | 12.419 | 11.928 |
| March 29, | 11.396 | 11.904 | 11.400 | 11.908 | October 14, | 12.330 | 11.843 |
| April 2, | 11.382 | 11.882 | 11.314 | 11.814 | October 18, | 12.389 | 11.913 |
| April 2, | 11.396 | 11.896 | 11.317 | 11.817 | October 18, | 12.387 | 11.911 |
| Means | 11.357 | 11.858 | 11.329 | 11.831 | | 12.326 | 11.832 |
| Probable errors | | ±.009 | | ±.014 | | | ±.026 |

Observed difference, 12.326 — 11.329 = 0.997 km per sec.
Theoretical difference, 0.501 + 0.494 = 0.995 km per sec.

Thus the value of the solar distance happens to come out two-thousandths larger than the adopted value, and the solar wave-lengths are the same in the means of the two groups of spring and autumn observations. The method will probably yield values of the solar distance comparable with those obtained by other spectroscopic methods,—and in any event it will be interesting to have the comparison by this new method.

## NOTES ON THE SOLAR ROTATION.

By Ralph E. De Lury and John L. O'Connor.

Since last year the sixty-five observations at λ5590, which were made simultaneously at 45° latitude in the four quadrants and which yielded a value of the velocity of the solar rotation 5 per cent greater for the southern than for the northern hemisphere, were remeasured in the opposite directions to the previous measurements with the following mean results of all the measures:

| λ | Element, and Intensity | North, 45° km/sec. | South, 45° km/sec. | Difference km/sec. |
|---|---|---|---|---|
| 5586.991, | Fe, 7 | 1.176 | 1.204 | 0.028 |
| 5587.800, | Fe, 0 | 1.128 | 1.192 | 0.064 |
| 5588.084, | Ni, 1 | 1.149 | 1.228 | 0.079 |
| 5588.985, | Ca, 6 | 1.209 | 1.231 | 0.022 |
| 5589.582, | Ni, 0 | 1.146 | 1.216 | 0.070 |
| 5590.343, | Ca, 3 | 1.188 | 1.239 | 0.051 |
| | Mean | 1.166 | 1.218 | 0.052 |
| Mean velocity for lines, Fe, 7; Ca, 6; Ca, 3; Average intensity, 5.3 | | 1.191 | 1.225 | 0.034 |
| Mean velocity for lines, Fe, 0; Ni, 1; Ni, 0; Average intensity, 0.3 | | 1.141 | 1.213 | 0.072 |
| | Difference | 0.050 | 0.012 | 0.038 |

Thus, with the smaller values of the northern hemisphere are associated the greater differences between weak and strong lines. A greater amount of blended spectrum in the northern than in the southern spectra would explain this. This in turn might be produced by a greater amount of meteoric matter in the northern than in the southern hemisphere, a condition which might result from the fact that the northern hemisphere of the sun advances through space preceding the southern.

Furthermore, the northeastern limb appears to be approaching more slowly than the southeastern while the north and southwestern limbs appear to be receding at the same rate. To explain this on the assumption of a blended spectrum a greater source might be supposed in the northeastern limb during the times of observation; or owing to the fact that the wave-lengths of the lines measured are greater at the limb than at the centre, the eastern wave-lengths (due to motion towards the observer) would be more nearly those of the centre wave-lengths than would the western limb wave-lengths, and consequently a greater general amount of blended spectrum in the northern hemisphere would produce its greatest effect on the northeastern wave-lengths.

If the effect is a real effect in the solar surface it may be found to vary with sun-spots or with the asymmetry in the numbers of spots, faculae and prominences in the northern and southern hemispheres. Hubrecht's greater values for the northern hemisphere were obtained near sun-spot minimum (1911), while our smaller values of the northern hemisphere were obtained from observations near sun-spot maximum (1918-19).

At latitudes 25°-35°, the results obtained for spots (Carrington, 1856-61) show a value for the northern 2 per cent greater than for the southern hemisphere; and (Mr. and Mrs. Maunder, 1879-1901) southern greater than northern 0.5 per cent; for faculae (Stratonoff, 1891-94) southern greater than northern 1 per cent; calcium flocculi (Hale and Fox, 1893-94), southern greater than northern 2 per cent. All such measures should be carefully considered in point of time.

Further light will be thrown on the problem by wave-length determinations we are making around the limb and along various diameters of the solar disc.

## MAP OF MARS IN 1920 AND METHOD OF PRODUCING IT FROM DRAWINGS.

By A. E. Douglass.

The method consists in the use of a camera lucida prism by means of which each drawing is projected and copied on a small globe, producing a composite picture. This is readily worked into a map. Errors

in the original drawings may be recognized immediately and classified. The necessity of standardizing one's work by the study of artificial planets is emphasized.

## A PHOTOMETRIC STUDY OF Y CAMELOPARDALIS.

By R. S. Dugan.

A preliminary report of the discussion of a mean light-curve of Y Camelopardalis which has been formed from observations made with the polarizing photometer at Princeton.

The eclipses are partial and last about 12½ hours each. The primary minimum is substantially symmetrical, and the shallow secondary minimum is displaced about 1.3 hours toward the following primary minimum. The depths of the minima due to eclipse alone amount to $1^M.52$ and $0^M.03$. On the assumption of uniformly illuminated disks the faint star is found to be slightly larger than the bright star. The "darkened" solution makes the bright star the larger, the ratio of diameters being 1/0.85.

Some of the other results of the darkened solution are:

| | |
|---|---|
| Ratio of short radius to long radius of each star | = 0.959 |
| Ratio of radii of the two stars | = 0.847 |
| Fraction of light of bright star lost at primary minimum | = 0.975 |
| Maximum radius of bright star | = 0.270 |
| Maximum radius of faint star | = 0.228 |
| Inclination of orbit plane | = 85°.6 |
| Ratio of intensities, bright side to faint side of faint star | = 5.3 |
| Ratio of intensities, bright star to faint side of faint star (as at primary min.) | = 120 |
| Ratio of total light of stars (as at primary min.) | = 167 |
| Equal-mass densities in terms of the sun | = 0.03 and 0.05 |

## THE PHOTOMETRIC FIELDS OF THREE YERKES TELESCOPES.

By Alice H. Farnsworth.

The discussion includes the determination of corrections for distance from the optical axis in the fields of the 40-inch refractor, 24-inch reflector, and 6-inch doublet, with the difficulties peculiar to each. The comparison of the color-curves of the 40-inch and 6-inch lenses shows their fitness for photography in the visual and photographic regions respectively. The curves of zonal foci derived from Hartmann tests furnish, in the case of the 6-inch doublet, a tentative explanation of the form of the calibration curves. Partial gratings, used successfully on the 24-inch and 40-inch for the determination of magnitude-scale, give distorted images on the doublet. Measures of the artificial

scales show that the increase in diameter of an image corresponding to a given increase in time of exposure is three times as great on the 40-inch plates as on the others. Nevertheless the precision of the photometric results is practically the same for the 40-inch and the reflector. Curves relating exposure time with limiting magnitude obtained on the plate show the comparative efficiency of the three instruments; at the same time the wide range of values used for the single curves reveal the great uncertainties introduced by varying atmospheric conditions.

## CIRCULATION OF CALCIUM FLOCCULI ABOUT SUN-SPOTS.

By Philip Fox.

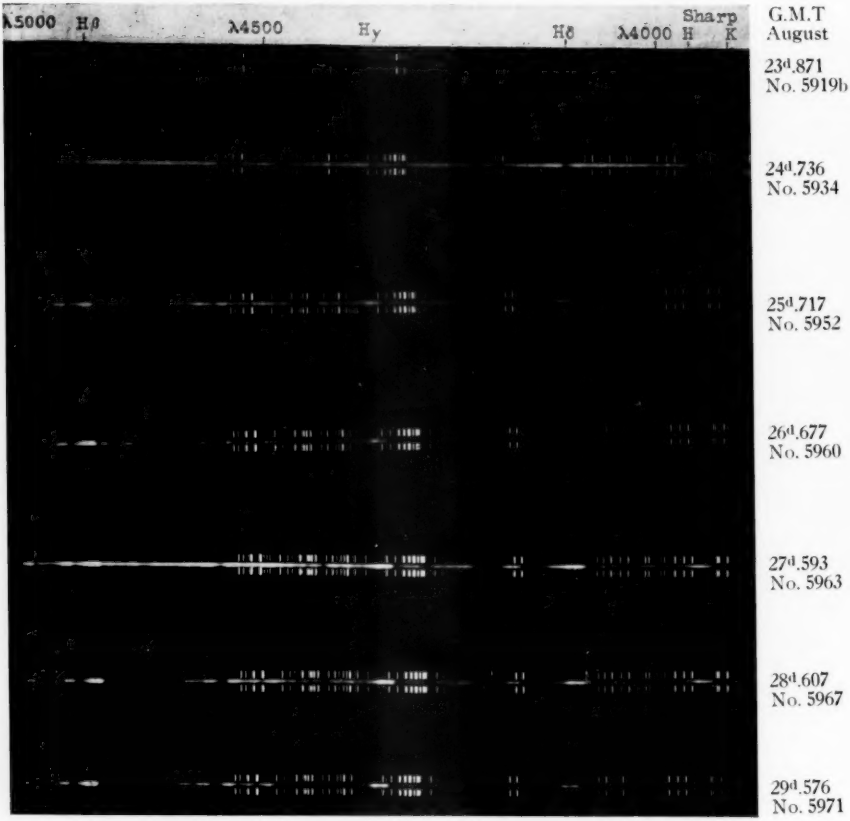
The measures of points on the calcium flocculi, made for the determination of the solar rotation, have been used to investigate the circulation about the spots. The excess or defect of the angular diurnal motions from the mean for the particular latitude was derived for each point associated with a spot and these were grouped according to position about single spots or about each member of bipolar spots as: preceding, poleward-preceding, poleward, poleward-following, following, equatorward-following, equatorward, and equatorward-preceding.

The series of spectroheliograms were made with the Rumford spectroheliograph of the Yerkes Observatory in the years 1903 to 1908. For this period the motion about single spots seems to be definitely anti-cyclonic. This is uniformly indicated for both hemispheres, for the beginning as well as the end of the series, and for both high and low heliographic latitudes. For the early dates and for the higher latitudes (in general the same points are involved) the anti-cyclonic indication is less pronounced than for the later dates or lower latitudes.

The motion about bipolar spots is cyclonic for the leader and anti-cyclonic for the trailer. For the later dates and lower latitudes the cyclonic character about the leader is enhanced and the indication of anti-cyclonic motion about the following spot is diminished. This may have direct bearing on the change of polarity noted at Mt. Wilson.

The average distance of the measured points from the spot centers is about three heliographic degrees. If their motions can be accepted as indicating the direction of circulation about the spots some interesting consequences arise. The principal one is, that the direction of whirl in the vortex together with the determined magnetic polarity gives at once the sign of the predominating charge on the whirling material. As Hale and his associates found like magnetic polarity for single spots and for the preceding member of bipolar groups and as here the whirl is shown to be in opposite directions we are led to

PLATE XXIII




NOVA CYGNI NO. 3, AUGUST 23-29, 1920.

Examples of spectrograms taken at Yerkes Observatory with a dispersion of one prism, by S. B. Barrett. The comparison spectrum is titanium and iron.

the conclusion that the dominant charge is of opposite sign. This may have important bearing on the law of spot development.

(Full treatment will appear as a section of a paper on the Solar Rotation in *Publications of the Yerkes Observatory*, Vol. III.)

## NOTE TO ACCOMPANY SPECTROGRAMS OF NOVA CYGNI NO. 3 TAKEN WITH THE BRUCE SPECTROGRAPH OF THE YERKES OBSERVATORY.

By Edwin B. Frost.

Since we received the first dispatch regarding the Nova, on Monday afternoon, August 23, the star has been observed assiduously by Professor Barrett, assisted by Mr. Sullivan and occasionally by the writer. In all 78 spectrograms were thus obtained from the 23rd to the 30th inclusive. They cover each night of the week, and one spectrum for each of the seven nights is shown on the cut.

It is of course well known that a very different impression of the spectrum, particularly in respect to bright lines, is given by the use of different dispersions. The dispersion at λ 4481, 30A per mm, is rather high for the detection of bright lines in early stages of a nova, so that it would be hardly proper to state that with this dispersion bright lines were present on August 23 or August 24, although they could be suspected at Hβ, Hγ and Hδ on the 24th and a bright Hβ could be imagined even on the 23rd.

The principal features on the 23rd are the simplicity of the spectrum, of an early A type, with the dark hyrogen lines displaced toward the violet by about 6 A. Beside the diffuse dark H and K lines, having that displacement of —6 A, dark, sharp H and K were particularly noticeable, practically undisplaced. Hε was doubtless mingled as a diffuse dark line with diffuse H (calcium), being thus thrown by the displacement far on the violet side of sharp H of calcium.

On the night of August 24, the dark lines were faintly divided at Hβ and Hγ. At Hγ the displacements were about — 12 and — 9 A, and Hβ — 17 and — 12 A. No changes in H and K. There is a suspicion of a bright fringe on the side toward red of sharp H and K.

On the 25th the expected change had occurred and broad bright lines were in evidence at Hβ, Hγ, Hδ, H and K, and elsewhere. The displacements of the dark lines had changed only slightly from the night before.

On the 26th the bright lines are still more conspicuous relative to the continuous spectrum. The cut shows those at about 5016 and 4923. The displacements of the dark lines, which no longer appear double, are about — 12 A.

On the 27th, the bright lines are continuing to increase relatively to the continuous spectrum and a few additional dark lines are becoming stronger. Here may be mentioned those at λ 4606 and at 4432, and a fainter one at λ 4455. These last may be the enhanced lines of titanium at 4443 and 4468. The displacement of dark gamma was about — 14 A.

On the 28th the width of bright H$\beta$ was approximately 40 units, with the center slightly displaced toward the red.

On the 29th the increase in the intensity of the bright lines continues and a considerable number of new ones make their appearance. The displacements of the dark lines have not greatly changed.

The star is making the normal progress of a nova, but more slowly than in recent instances.

On the 30th the bright H$\beta$, bright H$\gamma$ and bright H$\delta$ were distinctly double, with the center of the separation displaced about 2 A toward the red.

Professor Barnard's careful estimates made the magnitude of the star about 2.0 on the 23rd and the 24th, 2.7 on the 25 and 3.9 on the 29th.

We are trying to make a comparison of the dates at which corresponding stages were reached in the progress of Nova Geminorum, Nova Aquilae and Nova Cygni. The course of the development might well be a function of the mass.

The approximate measurements of these plates have been made by Miss Frances Lowater, who has rendered very valuable assistance in this preliminary work.

Yerkes Observatory, August 31, 1920.

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## OCCULTATIONS OF STARS BY THE MOON.

By FREDERICK R. HONEY.

The tables giving the places of the stars which are occulted by the moon, and which are arranged in the order of the right ascensions of the stars, show *in general* an increase or decrease in their declinations. The variations in declination are due partly to the changing position of the moon in its orbit which is alternately above and below the ecliptic; and also to a variation in the maximum declination from year to year which increases or decreases for 9.3 years. These periods of increase and decrease are included in the 18.6 years period during which there is a complete exhibit of the range of declination within which occultations are possible, and which are due to the regression of the node of the moon's orbit.

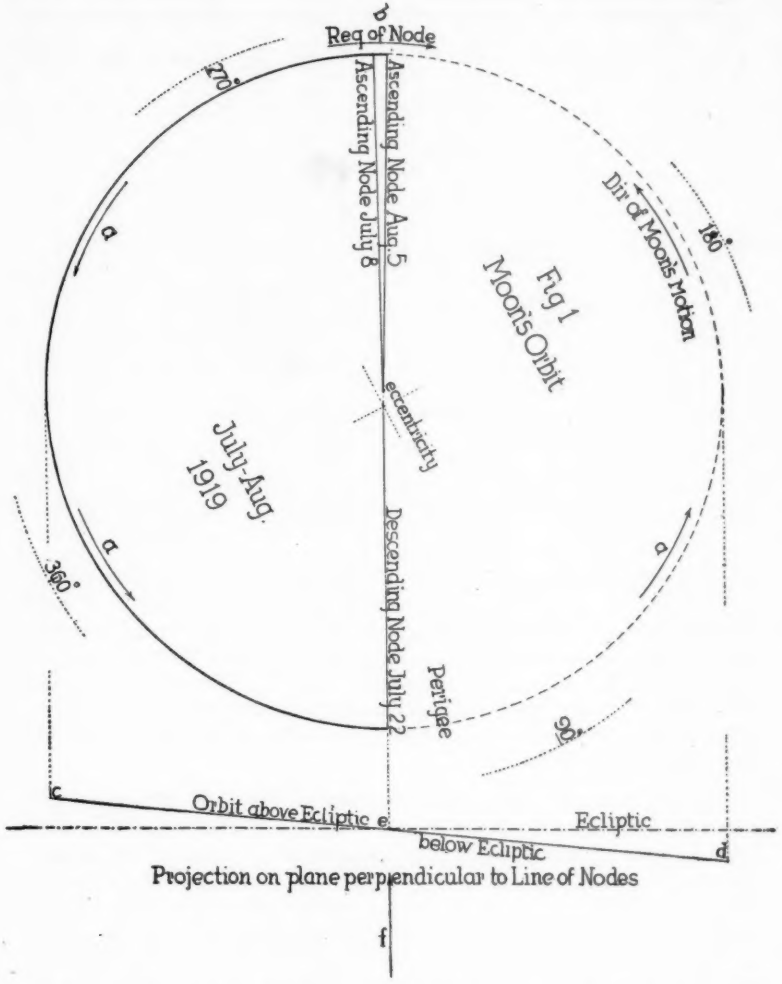
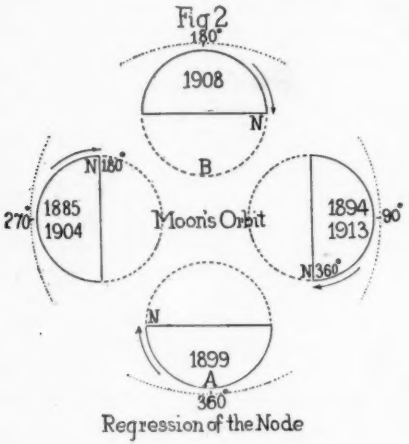



Figure 1 is a plot of the moon's orbit for one month (July-August, 1919). The arrows *a* show the direction of the moon's motion, and the arrow *b* the direction of the regression of the node between the dates July 8 and August 5. The heavy line represents that part of the orbit which is above the ecliptic, and the remainder that part which is below. If the orbit be projected on a plane which is perpendicular to the line of nodes, i. e., if it be represented as seen in the direction of the arrow *f*, the edge view *cd* shows its position relative to the ecliptic.

The positions of the orbit at intervals of four years and eight months ($=\frac{18.6}{4}$) for 1894, 1899, 1904, and 1908, are shown in Fig. 2 for




one complete rotation of the node N in the direction of the arrows—the orbit returning to its first position after an interval of 18.6 years, and labelled 1894 and 1913. In each position the full line represents that part of the orbit which is above the ecliptic, and the other half the part which is below. It was this constantly changing position of the orbit between 1894 and 1904 which resulted in the diminution of the maximum declination of the stars occulted; and then of the increase of the declination from 1904 to 1913.

Figure 3 shows the positions of the orbit in the years 1894 and 1904 when the longitudes of the node were respectively 360° and 180°. The line of nodes in each position is perpendicular to the plane of the paper, and is projected upon it at the point E, the centre of the earth. The plane of the orbit in each case is perpendicular to the plane of the paper, and is projected in a straight line which forms with the plane of the ecliptic an angle of 5° 9′, shown in its true value. The plane of the celestial equator, or right ascension circle, is also perpendicular to the plane of the paper, and is represented by a straight line which forms with the ecliptic an angle of 23° 27′. In order to avoid confusion in the drawing only parts of the orbits in the intermediate position, i. e., in 1899 and 1908, are shown. These positions should be compared with those in Fig. 1, which are labelled A and B. In 1899 that part of the orbit A which is above the ecliptic; and in 1908 that part of the orbit B which is below the ecliptic, are traced on the visible half of the celestial sphere, i. e., on the same side as the reader.

Fig 3

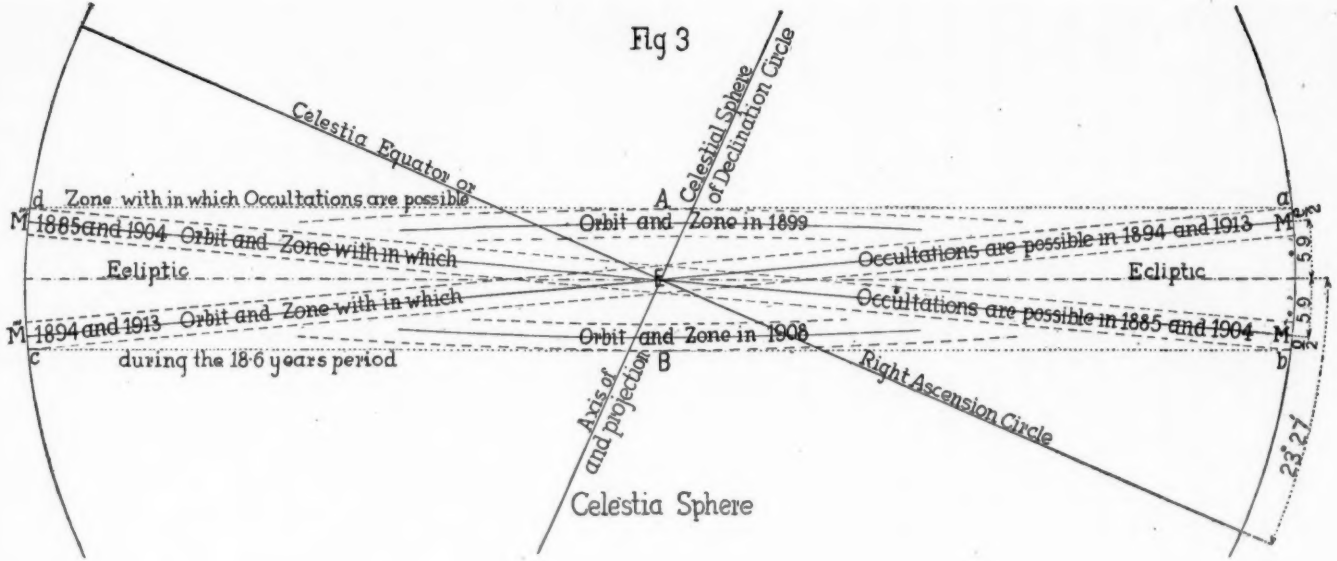
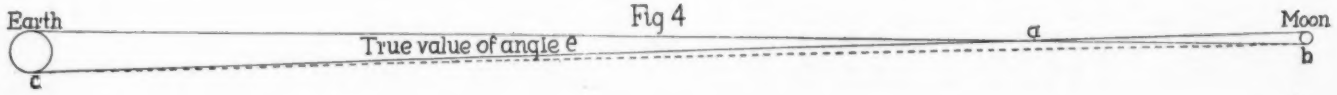

Celestia Equator or
Celestial Sphere
of Declination Circle
d Zone with in which Occultations are possible
A
a
M 1885 and 1904 Orbit and Zone with in which
Orbit and Zone in 1899
Occultations are possible in 1894 and 1913 M
Ecliptic
E
Ecliptic
M 1894 and 1913 Orbit and Zone with in which
Occultations are possible in 1885 and 1904 M
Orbit and Zone in 1908
c
during the 18·6 years period
B
b
Axis of
and projection
Right Ascension Circle
23°27'
Celestia Sphere

Fig 4


Earth
Moon
True value of angle e
a
c
b

When the moon is in the positions M and M′, i. e., at the maximum distances above and below the ecliptic, its declinations are respectively $23° 27' \pm 5° 9' = +28° 36'$ and $+18° 18'$. In the positions M″ and M‴ the declinations are respectively $-28° 36'$ and $-18° 18'$.

Figure 4. In order to ascertain the width of the zone within which occultations are possible, the earth, the moon, and the mean distance between them, are drawn to the same scale. The common tangents which cross at the point $a$ determine the angle $\theta$. The point $a$ divides the moon's distance from the earth into parts which are proportional to the radii of the earth and moon, i. e., very nearly in the proportion $11:3 \left(=\frac{3963.34}{1079.96}\right)$. Multiplying the terms of this proportion by 4.3 we have the proportion 47.3 : 12.9; and the sum of these terms = 60.2, which represents very nearly the mean distance between the earth and the moon expressed in terms of the earth's radius. The sine of one-half of $\theta = \frac{1}{47.3} = 0.02114$, which is the sine of 1° 12′ +. The value of $\theta$ is therefore about 2° 25′.

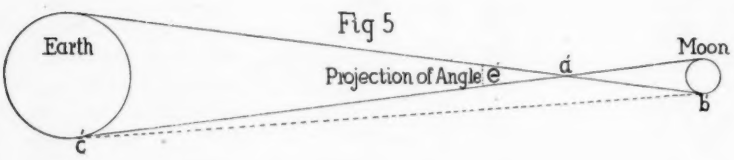
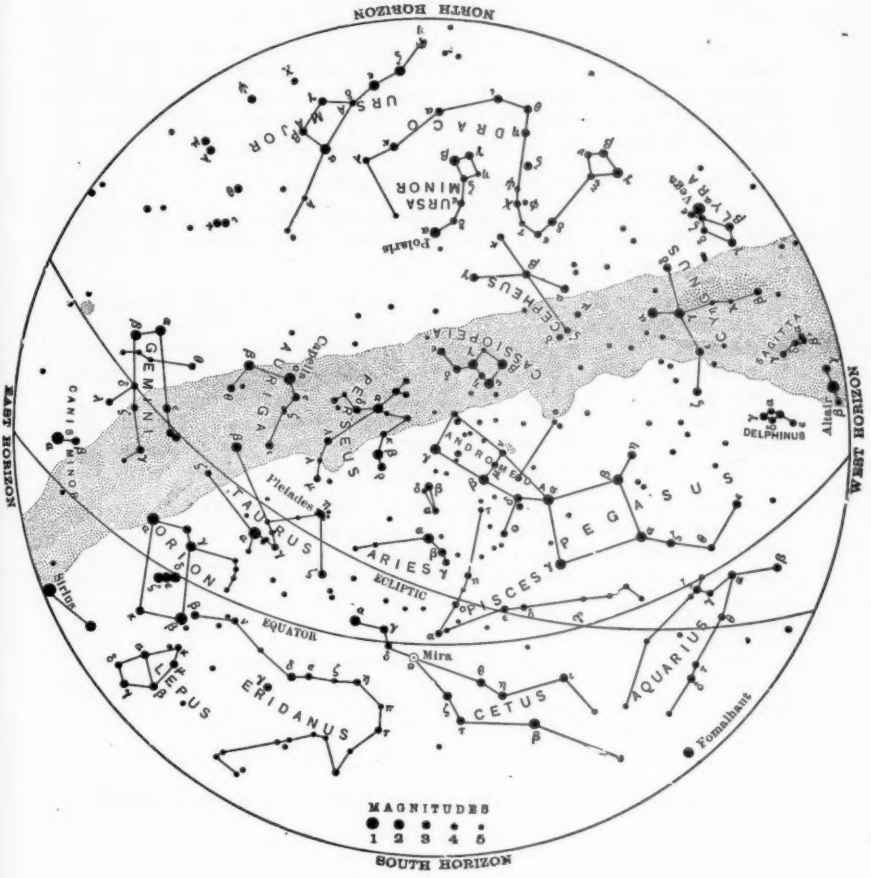



Figure 5. In order that the intersection of the tangents at $a$ may be more clearly defined, the earth and moon are drawn to a larger scale, and the distance between them is diminished to one-sixth of its true value. The radius of the moon's orbit forms with the plane of the paper an angle of between 80° and 81°; and the angles of the triangle *abc* are therefore shown in projection. The angle $\theta$ is equal to the sum of the angles *abc* and *acb;* that is to say the angle is equal to the apparent diameter of the earth as seen from the moon increased by the apparent diameter of the moon as seen from the earth. The moon's mean parallax = 57′; and its mean semi-diameter = 15′.5. Therefore $\theta = 2\,(57' + 15'.5) = 2° 25'$, which corresponds with the computation given above.

The sum of the angles 23° 27′, 5° 9′, and 1° 12′.5 is 29° 48′.5, the maximum declination; and the zone of the celestial sphere *abcd* is the area within which occultations are possible during the 18.6 years period.

## PLANET NOTES FOR DECEMBER, 1920.




THE CONSTELLATIONS AT 9:00 P. M. DECEMBER 1.

### Moon's Phases

| | | | | | |
|---|---|---|---|---|---|
| Last Quarter | December | 2 | at | 10:29 | P.M. C.S.T. |
| New Moon | | 10 | " | 4:04 | " " |
| First Quarter | | 18 | " | 8:40 | " " |
| Full Moon | | 25 | " | 6:38 | " " |

The *Sun* enters Capricornus on the 21st day at 9:17 P. M. C. S. T. and winter begins.

*Mercury* may be seen in the southeastern sky shortly before sunrise during the first week of the month. It reaches its greatest elongation west on the third at which time it will be 20°.5 from the sun. At the time of elongation its stellar magnitude will be —0.3, or about 2½ times as bright as Rigel.

*Venus* will be visible in the southwestern sky immediately after sunset. The planet's apparent distance from the sun will increase during the month as it is approaching eastern elongation. The image as seen through a telescope will be gibbous. The stellar magnitude will be —3.5 at the beginning and —3.7 at the end of the month.

The *Earth* reaches perihelion on the 31st at 11 P. M. C. S. T.

*Mars* will still be visible in the southwest after sunset but it is now so far from the earth and at so low an altitude for northern observers that observations of value can hardly be made.

*Jupiter* will be in excellent position for observation during the morning hours. The planet will be in Leo throughout the month. It will be at quadrature on the tenth. On the morning of the fourth the two inner satellites will both be in eclipse when the planet rises. The first will reappear from occultation at 2:59 A. M. and the second at 3:36 A. M. On the morning of the 11th both of the satellites will again be eclipsed but the disappearance will be visible this time, thus, the second will pass into Jupiter's shadow at 12:47 A. M. and the first at 1:22 A. M. The first will then reappear at 4:52 A. M. and the second at 6:12 A.M.

*Saturn* will be near $\beta$ Virginis throughout December and only a few degrees east of Jupiter. On November 7 the Earth passes through the plane of the rings and from this date until February 22 we shall be on the unilluminated side of the ring system. It may be possible for observers with small telescopes to see the shadow of the ring thrown on the planet. During this period the ring system will repay repeated observation.

*Uranus* will be in Aquarius between the two 5th magnitude stars $\sigma$ and $c$ Aquarii. On an exceptionally good night it may be possible to catch a glimpse of the planet with the unaided eye.

*Neptune* will be in Cancer near the 6th magnitude star $\pi$ Cancri.

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**Occultations Visible in the United States, December, 1920.**

[NOTE:—Geographical positions are indicated by giving for each point, first the latitude, then the longitude, the two being separated by a hyphen. A line drawn on a map through the two or more points thus indicated will mark approximately the limit of the region of visibility for the United States.

The time given is the approximate Greenwich time of the middle of the occultation as seen from the United States.]

Dec. 7, 1$^h$. 8 Librae, Mag. 5.3. South of 49°-124°, 43°-106°, 37°-93°, and west of long. 93°. (Farther east, occurs after sunrise.)

Dec. 7, 1$^h$. $\alpha$ Librae, Mag. 2.9. South of 50°-121°, 45°-107°, 39°-93°, and west of long. 93°. (Farther east, occurs after sunrise.)

Dec. 12, 12h. $\rho$ Sagit., Mag. 4.0. Northwest of 25°-106°, 31°-93°, 36°-81°, and west of 36°-81°, 49°-81°. (West of 32°-116°, 48°-125°, occurs before sunset.)

Dec. 15, 13h. $c^1$ Capr., Mag. 5.3. Northwest of 27°-101°, 35°-84°, 40°-66°.

Dec. 15, 13h. $c^2$ Capr., Mag. 6.3. North of 40°-127°, 50°-109°.

Dec. 16, 17h. $\kappa$ Aquarii, Mag. 5.2. South of 43°-125°, 45°-113°, 46°-97°, and west of 46°-97°, 38°-94°, 28°-93°.

Dec. 19, 17h. $\epsilon$ Pisc., Mag. 4.4. North of 32°-121°, 36°-103°, 37°-88°, 36°-74°.

Dec. 20, 13h. 54 Ceti, Mag. 6.0. Northwest of 44°-125°, 50°-114°.

Dec. 20, 19h. 26 B. Ariet., Mag. 6.0. Throughout U. S. except eastern Maine.

Dec. 21, 17h. $\delta$ Ariet., Mag. 5.5. North of 30°-114°, 33°-103°, 34°-85°, 33°-75°.

Dec. 21, 23h. 145 B. Ariet., Mag. 6.5. West of 50°-101°, 40°-105°, 30°-111°.

Dec. 22, 22h. 163 B. Tauri, Mag. 5.8. South of 45°-126°, 42°-111°, 38°-97°, 32°-79°.

Dec. 23, 13h. 302 B. Tauri, Mag. 6.1. Throughout U. S. except southern Florida.

Dec. 23, 15h. *i* Tauri, Mag. 5.1. Throughout U. S. except south of 28°-105°, 31°-92°, 33°-78°.

Dec. 23, 17h. 312 B. Tauri, Mag. 6.2. South of 30°-106°, 31°-92°, 30°-78°.

Dec. 23, 23h. *m* Tauri, Mag. 5.0. Northeast of 49°-124°, 42°-102°, 34°-78°.

Dec. 24, 23h. 19 B. Gem., Mag. 6.2. Throughout U. S. except northeast of 50°-95°, 44°-83°, 39°-70°.

Dec. 25, 16h. 110 B. Gem., Mag. 6.2. South of 37°-124°, 41°-104°, 45°-77°, 44°-62°.

Dec. 26, 0h. $\lambda$ Gem., Mag. 3.6. Throughout U. S. except south of 40°-126°, 35°-113°, 28°-96°.

Dec. 26, 18h. 30 B. Cancri, Mag. 6.1. South of 48°-130°, 49°-105°, 47°-80°, 43°-69°.

Dec. 27, 17h. $\kappa$ Cancri, Mag. 5.1. North of 34°-123°, 36°-109°, 37°-93°, 36°-76°.

Dec. 28, 3h. $\omega$ Leonis, Mag. 5.5. West of 35°-124°, 44°-115°, 50°-108°. (Farther east, occurs after sunrise.)

Dec. 30, 1h. $p^5$ Leonis, Mag. 5.3. North of 50°-127°, 43°-114°, 36°-100°, and west of 36°-100°, 43°-90°, 50°-81°. (Farther east, occurs after sunrise.)

ARTHUR SNOW,
Ass't. Nautical Almanac Office, U. S. Naval Observatory.

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## SEPTEMBER STARS.

Queen Vega—westward—seeks a lesser height,
The Cross of Cygnus sparkles overhead.
The "Eagle's Fam'ly" shine with saffron light,
And Fomalhaut is gleaming lone and red.

Arcturus blazes lower in the west,
Northeastwardly Capella glitters white,
The "Demon Star" adorns a hillock's crest,
Southwestwardly the "Archer" sets from sight.

The Lady's starry chair ascends the sky,
The Dipper's jewelled bowl turns upside down,
The Steed of Pegasus attracts the eye,
Above the Serpent gleams the Northern Crown.

Lo, o'er yon hillock, fringed with fragrant pines,
A white, round Harvest Moon sublimely shines.

CHARLES NEVERS HOLMES.
41 Arlington St., Newton, Mass.

## VARIABLE STARS.

### Minima of Variable Stars of Short Period.

[Calculated by members of the class in General Astronomy at Carleton College.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract $5^h$; Central Standard time $6^h$, etc.

| Star | R.A. 1900 | Decl. 1900 | Magnitude | Approx. Period | Greenwich mean times of minima in 1920 December | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | h m | ° ′ | | d h | d h | d h | d h | d h | d h | d h |
| SY Androm. | 0 08.0 | +43 09 | 9.5—13.0 | 34 21.8 | | | | 24 15 | | |
| RT Sculptor. | 31.5 | —26 13 | 9.6—10.5 | 0 12.3 | 1 19 | 9 11 | 17 3 | | 24 19 | |
| UU Androm | 38.5 | +30 24 | 10.7—11.9 | 1 11.7 | 7 10 | 14 20 | 22 7 | | 29 17 | |
| U Cephei | 0 53.4 | +81 20 | 7.0— 9.0 | 2 11.8 | 6 15 | 14 2 | 21 14 | | 29 1 | |
| Z Persei | 2 33.7 | +41 46 | 9.4—12 | 3 01.4 | 1 13 | 7 16 | 19 21 | | 26 0 | |
| TW Cassiop. | 37.6 | +65 19 | 8.2— 9.0 | 1 10.3 | 2 15 | 9 19 | 24 1 | | 31 5 | |
| RY Persei | 39.0 | +47 43 | 8.0—10.3 | 6 20.7 | 5 8 | 12 5 | 19 1 | | 25 22 | |
| RZ Cassiop. | 39.9 | +69 13 | 6.9— 8.1 | 1 04.7 | 5 18 | 12 22 | 20 2 | | 27 6 | |
| TX Cassiop. | 44.4 | +62 22 | 9.4—10.1 | 2 22.2 | 2 1 | 10 19 | 19 14 | | 28 8 | |
| ST Persei | 53.7 | +38 47 | 8.5—10.5 | 2 15.6 | 7 18 | 15 16 | 23 15 | | 31 14 | |
| RX Cassiop. | 2 58.8 | +67 11 | 8.6— 9.1 | 32 07.6 | | | 22 14 | | | |
| Algol | 3 01.7 | +40 34 | 2.3— 3.5 | 2 20.8 | 1 1 | 12 12 | 18 5 | | 29 17 | |
| RT Persei | 16.7 | +46 12 | 9.5—11.5 | 0 20.4 | 1 2 | 7 21 | 21 11 | | 28 6 | |
| λ Tauri | 55.1 | +12 12 | 3.3— 4.2 | 3 22.9 | 2 2 | 9 23 | 17 21 | | 25 19 | |
| RW Tauri | 3 57.8 | +27 51 | 7.1—<11 | 2 18.5 | 8 0 | 16 7 | 24 14 | | | |
| RV Persei | 4 04.2 | +33 59 | 9.5—11.0 | 1 23.4 | 4 9 | 12 7 | 20 4 | | 28 2 | |
| RW Persei | 13.3 | +42 04 | 8.8—11.0 | 13 04.8 | | 12 2 | 25 7 | | | |
| SZ Tauri | 31.4 | +18 20 | 7.2— 7.7 | 3 03.6 | 6 22 | 16 9 | 25 19 | | | |
| RS Cephei | 4 48.6 | +80 06 | 9.5—12.0 | 12 10.1 | 8 9 | | 20 19 | | | |
| TT Aurigæ | 5 02.8 | +39 27 | 7.8— 8.7 | 0 16.0 | 5 6 | 11 22 | 18 14 | | 26 6 | |
| RY Aurigæ | 11.5 | +38 13 | 10.7—11.7 | 2 17.5 | 4 23 | 13 4 | 21 8 | | 29 13 | |
| RZ Aurigæ | 42.9 | +31 40 | 10.6—13.3 | 3 00.3 | 5 17 | 11 17 | 23 18 | | 24 19 | |
| SV Tauri | 45.8 | +28 05 | 9.4—11.0 | 2 04.0 | 2 18 | 11 10 | 20 2 | | 28 18 | |
| Z Orionis | 50.2 | +13 40 | 9.7—10.7 | 5 04.9 | 8 5 | 18 15 | 29 1 | | | |
| SV Gemin. | 54.6 | +24 28 | 9.8—<11 | 4 00.2 | 2 11 | 10 11 | 18 12 | | 26 12 | |
| RW Gemin. | 5 55.4 | +23 08 | 9.5—11.0 | 2 20.8 | 2 2 | 7 20 | 19 7 | | 30 18 | |
| U Columbæ | 6 11.2 | —33 03 | 9.2—10.0 | 2 19.2 | 3 5 | 14 10 | 25 15 | | 31 5 | |
| SX Gemin. | 22.0 | +20 37 | 10.8—11.5 | 1 08.8 | 2 19 | 11 0 | 19 5 | | 27 10 | |
| RW Monoc | 29.3 | + 8 54 | 9.0—10.8 | 1 21.7 | 7 23 | 15 13 | 23 4 | | 30 19 | |
| RX Gemin. | 43.6 | +33 21 | 8.8— 9.6 | 12 05.0 | | 11 5 | 23 10 | | | |
| RU Monoc. | 6 49.4 | — 7 28 | 9.8—10.5 | 0 21.5 | 3 13 | 10 17 | 17 22 | | 25 2 | |
| R Can. Maj. | 7 14.9 | —16 12 | 5.8— 6.4 | 1 03.3 | 3 5 | 10 1 | 23 8 | | 30 12 | |
| RY Gemin. | 21.7 | +15 52 | 8.9—<10 | 9 07.2 | 6 14 | 15 21 | 25 4 | | | |
| Y Camelop. | 27.6 | +76 17 | 9.5—12 | 3 07.3 | 7 6 | 13 20 | 20 11 | | 27 2 | |
| TX Gemin. | 30.3 | +17 08 | 10.0—11.9 | 2 19.2 | 3 10 | 11 20 | 20 5 | | 28 15 | |
| RR Puppis | 43.5 | —41 08 | 9.4—10.7 | 6 10.3 | 1 21 | 8 7 | 21 4 | | 27 14 | |
| V Puppis | 7 55.4 | —48 58 | 4.1— 4.8 | 1 10.9 | 5 11 | 12 18 | 20 1 | | 27 7 | |
| X Carinae | 8 29.1 | —58 53 | 7.9— 8.7 | 0 13.0 | 2 20 | 10 22 | 19 2 | | 27 4 | |
| S Cancri | 8 38.2 | +19 24 | 8.2—10 | 9 11.6 | 4 10 | 13 21 | 23 9 | | | |
| RX Hydræ | 9 00.8 | — 7 52 | 9.1—10.5 | 2 6.8 | 1 5 | 8 1 | 21 18 | | 28 14 | |
| S Velorum | 29.4 | —44 46 | 7.8— 9.3 | 5 22.4 | 4 15 | 10 13 | 22 10 | | 28 8 | |
| Y Leonis | 9 31.1 | +26 41 | 9.3—11.2 | 1 16.5 | 1 20 | 8 14 | 22 2 | | 28 19 | |
| RR Velorum | 10 17.8 | —41 36 | 10.0—10.9 | 1 20.5 | 6 2 | 13 12 | 20 22 | | 28 8 | |
| SS Carinæ | 10 54.2 | —61 23 | 12.2—12.8 | 3 07.2 | 4 6 | 10 21 | 24 2 | | 30 16 | |
| ST Urs. Maj. | 11 22.4 | +45 44 | 6.7— 7.2 | 8 19.2 | 5 5 | 14 0 | 22 19 | | 31 14 | |
| RW Urs. Maj. | 35.4 | +52 34 | 10.3—11.4 | 7 07.9 | 7 4 | 14 12 | 21 20 | | 29 3 | |
| Z Draconis | 11 39.8 | +72 49 | 9.9—13.6 | 1 08.6 | 5 12 | 12 7 | 19 2 | | 25 21 | |
| RZ Centauri | 12 55.6 | —64 05 | 8.5— 8.9 | 1 21.0 | 3 15 | 11 3 | 18 15 | | 26 13 | |
| RS Can. Ven. | 13 06.3 | +36 28 | 7.5—12.5 | 4 19.1 | 8 6 | 17 21 | 27 11 | | | |
| SS Centauri | 07.2 | —63 37 | 8.8—10.4 | 2 11.5 | 2 14 | 10 1 | 17 11 | | 24 22 | |
| *133926* Hydræ | 13 39.0 | —26 23 | 8.6—12.7 | 2 21.5 | 2 5 | 8 1 | 19 14 | | 25 9 | |
| δ Libræ | 14 55.6 | — 8 07 | 4.8— 6.2 | 2 07.9 | 4 19 | 11 19 | 18 18 | | 25 18 | |

**Minima of Variable Stars of Short Period**—Continued.

| Star | R.A. 1900 | Decl. 1900 | Magnitude | Approx. Period | Greenwich mean times of minima in 1920 December | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | h m | ° ′ | | d h | d h | d h | d h | d h | d h | d h |
| U Coronæ | 15 14.1 | +32 01 | 7.6— 8.7 | 3 10.9 | 6 2 | 12 23 | 19 21 | 26 19 | | |
| TW Draconis | 32.4 | +64 14 | 7.3— 8.9 | 2 19.3 | 2 14 | 11 1 | 19 11 | 27 21 | | |
| SS Librae | 15 43.4 | —15 14 | 9.3—11.5 | 0 18.4 | 4 6 | 11 22 | 19 14 | 27 5 | | |
| SW Ophiuchi | 16 11.1 | — 6 44 | 9.2—10.0 | 2 10.7 | 2 16 | 10 0 | 17 8 | 24 17 | | |
| SX Ophiuchi | 12.6 | — 6 25 | 10.5—11.2 | 2 01.5 | 3 3 | 11 9 | 19 15 | 27 21 | | |
| R Aræ | 31.1 | —56 48 | 6.8— 7.9 | 4 10.2 | 4 1 | 12 21 | 21 17 | 30 14 | | |
| TT Herculis | 16 49.9 | +17 00 | 8.9— 9.3 | 20 18.1 | 9 1 | 18 18 | 29 19 | | | |
| TU Herculis | 17 09.8 | +30 50 | 9.5—12 | 2 06.4 | 6 4 | 12 23 | 19 18 | 26 13 | | |
| U Ophiuchi | 11.5 | + 1 19 | 6.0— 6.7 | 0 20.1 | 7 6 | 15 15 | 24 0 | | | |
| *u* Herculis | 13.6 | +33 12 | 4.6— 5.4 | 2 01.2 | 3 19 | 9 23 | 22 6 | 28 10 | | |
| TX Herculis | 15.4 | +42 00 | 8.3— 9.0 | 1 00.7 | 1 15 | 7 19 | 20 3 | 26 8 | | |
| RV Ophiuchi | 29.8 | + 7 19 | 9. —12 | 3 16.5 | 3 16 | 11 1 | 18 10 | 25 19 | | |
| SZ Herculis | 36.0 | +33 01 | 9.5—10.3 | 0 19.6 | 8 12 | 16 16 | 24 20 | | | |
| TX Scorpii | 48.6 | —34 13 | 7.5— 8.2 | 0 22.6 | 4 17 | 12 6 | 19 19 | 27 8 | | |
| UX Herculis | 49.7 | +16 57 | 8.8—10.5 | 1 13.2 | 6 21 | 14 15 | 22 9 | 30 3 | | |
| Z Herculis | 53.6 | +15 09 | 7.1— 7.9 | 3 23.8 | 5 23 | 13 23 | 21 23 | 29 22 | | |
| WX Sagittarii | 53.6 | —17 24 | 9.2—10.8 | 2 03.1 | 5 22 | 14 10 | 22 23 | 31 11 | | |
| WY Sagittarii | 17 54.9 | —23 1 | 9.5—10.6 | 4 16.0 | 6 6 | 15 14 | 24 22 | | | |
| SX Draconis | 18 03.0 | +58 23 | 9.3—10.5 | 5 04.1 | 4 15 | 15 0 | 24 8 | | | |
| RS Sagittarii | 11.0 | —34 08 | 5.9— 6.3 | 2 10.0 | 7. 9 | 14 15 | 21 21 | 29 3 | | |
| V Serpentis | 11.1 | —15 34 | 9.5—11.1 | 3 10.9 | 4 3 | 11 1 | 24 21 | 31 18 | | |
| RZ Scuti | 21.1 | — 9 15 | 7.4— 8.3 | 15 03.2 | 6 19 | | 21 22 | | | |
| RZ Draconis | 21.8 | +58 50 | 9.5—10.2 | 0 13.2 | 1 22 | 9 2 | 23 10 | 30 13 | | |
| RX Herculis | 26.0 | +12 32 | 7.0— 7.6 | 0 21.3 | 3 15 | 10 18 | 17 21 | 24 23 | | |
| SX Sagittarii | 39.7 | —30 36 | 8.7— 9.8 | 2 01.8 | 8 4 | 16 11 | 24 19 | | | |
| RR Draconis | 40.8 | +62 34 | 9.3—13 | 2 19.9 | 7 4 | 15 16 | 24 4 | | | |
| RS Scuti | 43.7 | —10 21 | 9.3—10.3 | 0 15.9 | 6 19 | 13 10 | 20 2 | 26 17 | | |
| *β* Lyræ | 46.4 | +33 15 | 3.4— 4.1 | 12 21.8 | 5 1 | 17 23 | 30 21 | | | |
| U Scuti | 18 48.9 | —12 44 | 9.1— 9.6 | 0 22.9 | 7 21 | 15 12 | 23 4 | 30 19 | | |
| RX Draconis | 19 01.1 | +58 35 | 9.3—10.2 | 1 21.4 | 4 5 | 11 19 | 19 8 | 26 22 | | |
| RV Lyræ | 12.5 | +32 15 | 11. —12.8 | 3 14.4 | 2 21 | 10 2 | 17 6 | 24 11 | | |
| RS Vulpec. | 13.4 | +22 16 | 6.9— 8.0 | 4 11.4 | 6 19 | 15 18 | 24 17 | | | |
| U Sagittæ | 14.4 | +19 26 | 6.5— 9.0 | 3 09.1 | 2 2 | 8 20 | 22 9 | 29 3 | | |
| Z Vulpec. | 17.5 | +25 23 | 7.3— 8.5 | 2 10.9 | 3 15 | 11 0 | 18 8 | 25 17 | | |
| TT Lyræ | 24.3 | +41 30 | 9.4—11.6 | 5 05.8 | 5 8 | 10 13 | 21 1 | 26 7 | | |
| UZ Draconis | 26.1 | +68 44 | 9.0— 9.8 | 1 15.1 | 5 9 | 11 22 | 18 10 | 24 23 | | |
| SY Cygni | 19 42.7 | +32 28 | 10 —12 | 6 00.2 | 4 7 | 10 7 | 22 7 | 28 7 | | |
| WW Cygni | 20 00.6 | +41 18 | 9.3—13.4 | 3 07.6 | 5 13 | 12 4 | 18 20 | 25 11 | | |
| SW Cygni | 03.8 | +46 01 | 9. —11.7 | 4 13.8 | 7 5 | 16 8 | 25 12 | | | |
| VW Cygni | 11.4 | +34 12 | 9.8—11.8 | 8 10.3 | 3 22 | 12 9 | 20 19 | 29 5 | | |
| RW Capric. | 12.2 | —17 59 | 8.8—10.6 | 3 09.4 | 3 14 | 10 9 | 23 22 | 30 17 | | |
| UW Cygni | 19.6 | +42 55 | 10.5—13 | 3 10.8 | 5 18 | 12 16 | 19 3 | 26 11 | | |
| V Vulpec. | 32.3 | +26 15 | 8.2— 9.8 | 37 19.0 | | | 25 13 | | | |
| W Delphini | 33.1 | +17 56 | 9.4—12.1 | 4 19.4 | 8 21 | 18 12 | 28 2 | | | |
| RR Delphini | 38.9 | +13 35 | 10.5—11.8 | 4 14.4 | 8 17 | 17 22 | 27 3 | | | |
| Y Cygni | 48.1 | +34 17 | 7.1— 7.9 | 1 12.0 | 2 22 | 10 10 | 17 21 | 25 9 | | |
| WZ Cygni | 49.3 | +38 27 | 9.9—10.8 | 0 14.0 | 8 6 | 15 21 | 23 11 | | | |
| RR Vulpec. | 20 50.5 | +27 32 | 9.6—11.0 | 5 01.2 | 2 1 | 12 3 | 22 5 | | | |
| VVCygni | 21 02.3 | +45 23 | 12.1—13.8 | 1 11.4 | 2 20 | 10 5 | 17 14 | 24 23 | | |
| AE Cygni | 09.0 | +30 20 | 10.8—11.4 | 0 23.3 | 4 5 | 13 22 | 23 14 | | | |
| RY Aquarii | 14.8 | —11 14 | 8.8—10.4 | 1 23.2 | 7 0 | 14 20 | 22 17 | 30 14 | | |
| RT Lacertæ | 21 57.4 | +43 24 | 9.1—10.5 | 5 01.7 | 1 19 | 10 23 | 22 2 | | | |
| UZ Cygni | 55.2 | +43 52 | 8.9—11.6 | 31 07.3 | 2 22 | | | | | |
| RW Lacertæ | 22 40.6 | +49 08 | 10.2—11.2 | 5 04.4 | 1 3 | 6 7 | 16 16 | 27 1 | | |
| TT Androm. | 23 08.7 | +45 36 | 11.3—12.6 | 2 18.4 | 6 12 | 14 20 | 23 3 | 31 10 | | |
| Y Piscium | 29.3 | + 7 22 | 9.0—12.0 | 3 18.3 | 8 7 | 15 20 | 23 9 | 30 21 | | |
| TW Androm. | 23 58.2 | +32 17 | 8.6—11.5 | 4 02.9 | 1 14 | 9 20 | 18 2 | 26 8 | | |

## Maxima of Variable Stars of Short Period.

[Calculated by members of the class in General Astronomy at Carleton College.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract $5^h$; Central Standard time $6^h$, etc.

| Star | R.A. 1900 | Decl. 1900 | Magnitude | Approx. Period | Greenwich mean times of maxima in 1920 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | December | | | | | | | |
| | h m | ° ′ | | d h | d h | d h | d h | d h | d h | d h | d h | d h |
| SX Cassiop. | 0 05.5 | +54 20 | 8.6— 9.2 | 36 13.7 | 7 0 | | | | | | | |
| SY Cassiop | 0 09.8 | +57 52 | 9.3— 9.9 | 4 1.7 | 6 4 | 14 8 | 22 12 | 30 15 | | | | |
| RR Ceti | 1 27.0 | + 0 50 | 8.3— 9.0 | 0 13.3 | 5 11 | 13 5 | 20 23 | 28 17 | | | | |
| RW Cassiop. | 1 30.7 | +57 15 | 8.9—11.0 | 14 19.2 | | 12 17 | 27 12 | | | | | |
| V Arietis | 2 09.6 | +11 46 | 8.3— 9.0 | 0 23.8 | 4 19 | 13 18 | 20 17 | 28 15 | | | | |
| SU Cassiop. | 2 43.0 | +68 28 | 6.5— 7.0 | 1 22.8 | 3 15 | 11 10 | 19 5 | 27 1 | | | | |
| TU Persei | 3 01.8 | +52 49 | 11.4—12.2 | 0 14.6 | 6 6 | 13 13 | 20 20 | 28 3 | | | | |
| RW Camelop. | 3 46.2 | +58 21 | 8.2— 9.4 | 16 00.0 | | 14 . | | 30 | | | | |
| SX Persei | 4 10.2 | +41 27 | 10.4—11.2 | 4 07.0 | 8 13 | 17 3 | 25 17 | | | | | |
| SV Persei | 42.8 | +42 07 | 8.8— 9.6 | 11 03.1 | 1 23 | 12 2 | 23 5 | | | | | |
| RX Aurigæ | 4 54.5 | +39 49 | 7.2— 8.1 | 11 15.0 | 4 18 | 10 10 | 28 1 | | | | | |
| SX Aurigæ | 5 04.6 | +42 02 | 8.0— 8.7 | 1 12.8 | 3 17 | 11 9 | 19 1 | 26 16 | | | | |
| SY Aurigæ | 05.5 | +42 41 | 8.4— 9.5 | 10 03.3 | 9 14 | 19 17 | 29 20 | | | | | |
| Y Aurigae | 21.5 | +42 21 | 8.6— 9.6 | 3 20.6 | 1 3 | 8 20 | 16 14 | 24 7 | | | | |
| RZ Gemin. | 5 56.6 | +22 15 | 9.1—10.0 | 5 12.7 | 5 23 | 11 12 | 17 1 | 22 13 | | | | |
| RS Orionis | 6 16.5 | +14 44 | 8.2— 8.9 | 7 13.6 | 4 6 | 11 19 | 19 8 | 26 22 | | | | |
| T Monoc. | 19.8 | + 7 08 | 5.7— 6.8 | 27 00.3 | | | 21 13 | | | | | |
| RT Aurigæ | 23.0 | +30 33 | 5.1— 6.0 | 3 17.5 | 2 4 | 8 15 | 17 2 | 24 12 | | | | |
| RZ Camelop. | 23.7 | +67 06 | 11.0—13.0 | 0 11.5 | 8 2 | 15 6 | 22 12 | 29 16 | | | | |
| W Gemin. | 29.2 | +15 24 | 6.7— 7.5 | 7 22.0 | 3 16 | 11 14 | 19 12 | 25 10 | | | | |
| ζ Gemin. | 6 58.2 | +20 43 | 3.7— 4.3 | 10 03.7 | 3 17 | 13 21 | 24 1 | | | | | |
| RU Camelop. | 7 10.9 | +69 51 | 8.5— 9.8 | 22 06.5 | | 16 7 | | | | | | |
| RR Gemin. | 7 15.2 | +31 04 | 10.0—11.5 | 0 09.5 | 4 10 | 12 9 | 20 7 | 28 6 | | | | |
| V Carinæ | 8 26.7 | —59 47 | 7.4— 8.1 | 6 16.7 | 6 21 | 13 14 | 20 7 | 26 23 | | | | |
| T Velorum | 8 34.4 | —47 01 | 7.6— 8.5 | 4 15.3 | 9 4 | 18 11 | 27 18 | | | | | |
| V Velorum | 9 19.2 | —55 32 | 7.5— 8.2 | 4 08.9 | 3 0 | 11 17 | 20 11 | 29 5 | | | | |
| Z Leonis | 9 46.4 | +27 22 | 7.9— 9.6 | 59 00.0 | 4 | | | | | | | |
| RR Leonis | 10 02.1 | +24 29 | 9.1—10.1 | 0 10.9 | 3 3 | 9 22 | 22 12 | 30 6 | | | | |
| SU Draconis | 11 32.2 | +67 53 | 8.9— 9.6 | 0 15.8 | 3 10 | 10 0 | 23 5 | 29 20 | | | | |
| S Muscæ | 12 07.4 | —69 36 | 6.4— 7.3 | 9 15.8 | 8 21 | 17 13 | 27 4 | | | | | |
| SW Draconis | 12.8 | +70 04 | 8.8— 9.6 | 0 13.7 | 5 9 | 13 9 | 21 8 | 29 7 | | | | |
| T Crucis | 15.9 | —61 44 | 6.8— 7.6 | 6 17.6 | 3 15 | 10 9 | 23 20 | 30 13 | | | | |
| R Crucis | 18.1 | —61 04 | 6.8— 7.9 | 5 19.8 | 4 18 | 16 10 | 28 2 | | | | | |
| S Crucis | 12 48.4 | —57 53 | 6.5— 7.6 | 4 16.6 | 3 1 | 7 18 | 17 3 | 21 20 | | | | |
| W Virginis | 13 20.9 | — 2 52 | 8.7—10.4 | 17 06.5 | | 14 16 | | 31 23 | | | | |
| SS Hydræ | 25.0 | —23 08 | 7.4— 8.1 | 8 04.8 | 8 20 | 17 0 | 25 5 | | | | | |
| RV Urs. Maj. | 13 29.4 | +54 31 | 9.2— 9.9 | 0 11.2 | 4 17 | 11 18 | 18 18 | 25 19 | | | | |
| ST Virginis | 14 22.5 | — 0 27 | 10.3—11.4 | 0 09.9 | 8 16 | 16 21 | 25 2 | | | | | |
| V Centauri | 25.4 | —56 27 | 6.4— 7.8 | 5 11.9 | 3 2 | 8 14 | 19 14 | 25 2 | | | | |
| RS Bootis | 29.3 | +32 11 | 8.9—10.0 | 0 09.1 | 5 22 | 13 11 | 21 0 | 28 13 | | | | |
| RU Bootis | 14 41.5 | +23 44 | 12.8—14.3 | 0 11.9 | 3 3 | 10 13 | 17 23 | 25 9 | | | | |
| R Triang. Austr. | 15 10.8 | —66 08 | 6.7— 7.4 | 3 09.3 | 2 3 | 8 22 | 22 11 | 29 6 | | | | |
| S Triang. Austr. | 15 52.2 | —63 29 | 6.4— 7.4 | 6 07.8 | 2 17 | 9 1 | 21 16 | 28 0 | | | | |
| S Normæ | 16 10.6 | —57 39 | 6.6— 7.6 | 9 18.1 | 6 16 | 16 10 | 26 4 | | | | | |
| RW Draconis | 33.7 | +58 03 | 9.6—10.8 | 0 10.6 | 1 13 | 10 9 | 19 6 | 28 3 | | | | |
| RV Scorpii | 16 51.8 | —33 27 | 6.7— 7.4 | 6 01.5 | 5 10 | 11 11 | 23 14 | 29 16 | | | | |
| X Sagittarii | 17 41.3 | —27 48 | 4.4— 5.0 | 7 00.3 | 3 17 | 10 17 | 24 18 | 31 18 | | | | |
| Y Ophiuchi | 47.3 | — 6 07 | 6.1— 6.5 | 17 02.9 | 5 18 | | 22 21 | | | | | |
| W Sagittarii | 17 58.6 | —29 35 | 4.3— 5.1 | 7 14.3 | 4 18 | 12 9 | 19 23 | 27 13 | | | | |
| Y Sagittarii | 18 15.5 | —18 54 | 5.4— 6.2 | 5 18.6 | 3 23 | 9 18 | 21 7 | 27 1 | | | | |
| U Sagittarii | 26.0 | —19 12 | 6.5— 7.3 | 6 17.9 | 5 12 | 12 6 | 19 0 | 25 18 | | | | |
| Y Scuti | 32.6 | — 8 27 | 8.7— 9.2 | 10 08.3 | 11 7 | 21 16 | 31 0 | | | | | |
| Y Lyræ | 34.2 | +43 52 | 11.3—12.3 | 0 12.1 | 2 5 | 8 6 | 20 8 | 26 8 | | | | |
| RZ Lyræ | 18 39.9 | +32 42 | 9.9—11.2 | 0 12.3 | 6 4 | 12 8 | 24 14 | 30 17 | | | | |

**Maxima of Variable Stars of Short Period—Continued.**

| Star | R.A. 1900 | Decl. 1900 | Magnitude | Approx. Period | Greenwich mean times of maxima in 1920 December | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | h m | ° ′ | | d h | d h | d h | d h | d h | d h | |
| RT Scuti | 18 44.1 | —10 30 | 9.1— 9.7 | 0 11.9 | 6 16 | 12 14 | 24 12 | 30 11 | | |
| κ Pavonis | 18 46.6 | —67 22 | 3.8— 5.2 | 9 02.2 | 7 6 | 16 8 | 25 11 | | | |
| U Aquilæ | 19 24.0 | — 7 15 | 6.2— 6.9 | 7 00.6 | 6 20 | 13 21 | 20 21 | 27 22 | | |
| XZ Cygni | 30.4 | +56 10 | 8.6— 9.3 | 0 11.2 | 7 18 | 14 18 | 21 18 | 28 18 | | |
| U Vulpec. | 32.2 | +20 07 | 6.5— 7.6 | 7 23.5 | 8 2 | 16 1 | 24 1 | | | |
| SU Cygni | 40.8 | +29 01 | 6.2— 7.0 | 3 20.3 | 4 4 | 11 21 | 19 23 | 27 6 | | |
| η Aquilæ | 47.4 | + 0 45 | 3.7— 4.5 | 7 04.2 | 4 20 | 12 0 | 19 4 | 26 8 | | |
| S Sagittæ | 51.5 | +16 22 | 5.6— 6.4 | 8 09.2 | 3 1 | 11 10 | 19 20 | 28 5 | | |
| X Vulpec. | 19 53.3 | +26 17 | 9.5—10.5 | 6 07.7 | 5 15 | 11 22 | 24 14 | 30 21 | | |
| X Cygni | 20 39.5 | +35 14 | 6.0— 7.0 | 16 09.3 | | 17 9 | | | | |
| T Vulpec. | 47.2 | +27 52 | 5.5— 6.1 | 4 10.5 | 4 7 | 13 4 | 22 1 | 30 22 | | |
| WY Cygni | 52.3 | +30 03 | 9.6—10.4 | 0 13.5 | 3 13 | 10 6 | 23 17 | 30 11 | | |
| RV Capric. | 55.9 | —15 37 | 9.2—10.1 | 0 10.7 | 5 20 | 12 13 | 19 6 | 26 0 | | |
| TX Cygni | 20 56.4 | +42 12 | 8.5— 9.7 | 14 17.4 | 9 6 | | 24 0 | | | |
| VY Cygni | 21 00.4 | +39 34 | 8.8— 9.5 | 7 20.6 | 7 5 | 15 2 | 22 22 | 30 19 | | |
| SW Aquarii | 10.2 | — 0 20 | 9.9—10.8 | 0 11.0 | 3 18 | 10 15 | 24 10 | 31 7 | | |
| VZ Cygni | 21 47.7 | +42 40 | 8.2— 9.2 | 4 20.7 | 5 15 | 15 8 | 20 5 | 29 23 | | |
| Y Lacertæ | 22 05.2 | +50 33 | 9.1— 9.6 | 4 07.8 | 8 20 | 17 11 | 26 3 | | | |
| δ Cephei | 25.5 | +57 54 | 3.7— 4.6 | 5 08.8 | 1 1 | 11 19 | 22 12 | 27 21 | | |
| Z Lacertæ | 36.9 | +56 18 | 8.2— 9.0 | 10 21.1 | 5 6 | 16 3 | 27 0 | | | |
| RR Lacertæ | 37.5 | +55 55 | 8.5— 9.2 | 6 10.1 | 5 6 | 11 16 | 24 13 | 30 22 | | |
| V Lacertae | 44.5 | +55 48 | 8.5— 9.5 | 4 23.6 | 1 18 | 12 17 | 22 16 | 27 16 | | |
| X Lacertæ | 22 45.0 | +55 54 | 8.2— 8.6 | 5 10.7 | 4 8 | 9 18 | 20 16 | 31 13 | | |
| SW Cassiop. | 23 03.7 | +58 11 | 9.2— 9.7 | 5 10.6 | 2 17 | 13 13 | 24 11 | 29 21 | | |
| RS Cassiop. | 32.6 | +61 52 | 9.0—11.0 | 6 07.1 | 7 1 | 13 8 | 19 15 | 25 22 | | |
| RY Cassiop. | 47.2 | +58 11 | 9.3—11.8 | 12 03.4 | 2 2 | 14 6 | 26 9 | | | |
| V Cephei | 23 51.7 | +82 38 | 6.0— 7.0 | 0 23.9 | 3 7 | 17 6 | 24 5 | 31 5 | | |

## NOTES FOR OBSERVERS.

### Monthly Report of the American Association of Variable Star Observers, August 20 to September 20, 1920.

During the first month of the appearance of Nova Cygni No. 3 the Association has accumulated a total of 287 observations, covering every day of the month and at the first almost every hour, which constitutes a splendid contribution. These observations are included in condensed form in this report. Messrs. Lacchini, Ginori, McAteer, and Peltier submit especially commendable lists, and also a large number of observations of southern stars have been received from Messrs. Dawson and Tapia. It will be noted that Mr. Dawson's initial has been changed from "δ" to "Dw"; it is desirable to avoid if possible any unnecessary changes in these initials which designate observers, but the change in the form of the reports made it difficult for the type setter to use the Greek letter. It is hoped that no uncertainty will arise owing to this change.

The interest aroused by Nova Cygni is evident by the size of this report, and by the inclusion of reports from almost a score of new observers. They are Messrs. V. H. Cahalane, of Charlestown, N. H.; F. J. Carr, of Swanton,

Vt.; R. Furukawa, of Japan; C. H. Hall, Jr., of Baltimore, Md.; H. J. Lacy, of Owingsville, Ky.; S. D. Townley, of Palo Alto, Cal.; G. H. Waldo, of Bridgeport, Ct.; W. W. White, of Pittsfield, Mass.; and the Misses A. J. Cannon, of Cambridge, Mass.; M. Harwood, of Maria Mitchell Observatory, Mass.; M. A. Hawes, of Vassar College, N. Y.; Mrs. W. T. Olcott, of Norwich, Ct.; Miss S. Raymond; and Miss A. V. Walker, of Cambridge, Mass.

There were fifteen members who gathered together at the recent meeting of the A. A. S., and were entertained by Miss Young at the Observatory of Mount Holyoke College.

The Association continues to add to its membership, and the following names have recently been acted upon favorably by the Council:

| | |
|---|---|
| H. L. Alden, | University of Virginia, Va. |
| G. C. Fleming, | Medicine Hat, Alberta, Canada. |
| R. W. French, | Cincinnati, O. |
| Ryujo Furukawa, | Kyoto, Japan. |
| H. G. Gibson, | Philadelphia, Pa. |
| H. O. Hastings, | Holyoke, Mass. |
| M. F. Jordan, | University of Maine, Orono, Me. |
| Howard Kaster, | Berkeley, Cal. |
| Gerold Merton, | Woldingham, England. |
| S. D. Townley, | Palo Alto, Cal. |
| Issei Yamamoto, | Kyoto, Japan. |

Mr. Alden submits a very fine list of Nova Cygni, but owing to the fact that his observations are included in the publications of the Leander McCormick Observatory, they will hereafter be omitted from the reports of the Association. Those published herewith are indicated by the initial "Ad".

Attention is called to the plans which are being made for the Annual Meeting of the Association, at Harvard College Observatory, Cambridge, Mass., on November 6. A large attendance is already assured and a most interesting program is being prepared. Those intending to be present should notify the Committee on Arrangements, at the Harvard College Observatory, as soon as possible.

Plans for the mid-west meeting have been going forward and the consensus of opinion of those consulted is that this should be held late in December at the time of the A. A. A. S. meeting.

The following observers contributed to this report: Messrs. Alden, "Ad", Barns, "Bs", Benini, "Be", Miss Block, "Bk", Bouton, "B", Brown, "Bn", Cahalane, "Cn", Miss Cannon, "Co", Carr, "Ca", Chandra, "Ch", Clement, "Cl", Dawson, "Dw", Eaton, "E", Furukawa, "Fk", Gartlein, "Ga", Ginori, "Gi", Godfrey, "Gd", Hall, "Hl", Miss Harwood, "Hw", Miss Hawes, "Hs", Henckel, "Hn", M. J. Jordan, "Jd", Kimball, "K", Lacchini, "L", Lacy, "Lc", Luyten, "Lt", McAteer, "M", Menzel, "Mz", Mundt, "Mu", Olcott, "O", Mrs. Olcott, "Mo", Peltier, "Pt", de Perrot, "Pe", Peters, "Ps", Pickering, "Pi", Potter, "Po", Miss Raymond, "Rm", Rhorer, "Ro", Suter, "Su", Tapia, "Tp" Townley, "To", Vrooman, "V", Waldo, "Wl", Miss Walker, "Wk", White, "Wt", Miss Woods, "Wo", Yalden, "Ya", and Yamamoto, "Ym".

HOWARD O. EATON,
Recording Secretary.

VARIABLE STAR OBSERVATIONS, August 20 to September 20, 1920.

Aug. 0 = J.D. 2422537 Sept. 0 = J.D. 2422568

| Number | Name | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *001032* | S Sculpt. | 2521.7 | 12.1 | Dw. | | | | | | | | | |
| 001046 | X Androm. | 2587.6 | *14.2* | M. | | | | | | | | | |
| *001620* | T Ceti | 2554.6 | 6.7 | L. | | | | | | | | | |
| 001726 | T Androm. | 2544.3 | *12.8* | Pe. | | | | | | | | | |
| 001755 | T Cassiop. | 2554.4 | 11.9 | L, | 2560.7 | *12.0* | Bs, | 2561.7 | 11.3 | Mz, | 2563.4 | 10.8 | Gi, |
| | | 2573.6 | 10.5 | O, | 2575.7 | 9.8 | B, | 2577.7 | 11.5 | Bs, | 2584.6 | 10.7 | Pi, |
| | | 2584.8 | 10.8 | M. | | | | | | | | | |
| 001838 | R Androm. | 2543.3 | *12.4* | Pe, | 2573.6 | *10.6* | Hn, | 2587.6 | 14.6 | M. | | | |
| *001909* | S Ceti | 2554.6 | *12.1* | L, | 2584.8 | *11.5* | M. | | | | | | |
| *002438* | T Sculptoris | 2521.7 | 9.9 | Dw. | | | | | | | | | |
| *002546* | T Phoenic. | 2521.7 | 9.9 | Dw. | | | | | | | | | |
| 003179 | Y Cephei | 2584.8 | *10.7* | M. | | | | | | | | | |
| 004047 | U Cassiop. | 2548.3 | *12.2* | Pe, | 2558.3 | *12.1* | Pe, | 2577.6 | *12.9* | B, | 2584.8 | *12.0* | M, |
| | | 2587.6 | 13.0 | M. | | | | | | | | | |
| 004746a | RV Cassiop. | 2578.6 | *14.0* | B. | | | | | | | | | |
| 004958 | W Cassiop. | 2561.7 | 9.6 | Mz, | 2573.6 | 9.6 | O, | 2574.6 | 9.8 | Pt, | 2575.7 | 8.9 | B, |
| | | 2587.6 | 9.7 | Pi. | | | | | | | | | |
| 010940 | U Androm. | 2584.8 | 11.4 | M. | | | | | | | | | |
| 011041 | UZ Androm. | 2584.8 | 11.4 | M. | | | | | | | | | |
| 011208 | S Piscium | 2580.7 | 11.3 | V. | | | | | | | | | |
| 011272 | S Cassiop. | 2560.6 | 10.9 | Cl, | 2561.8 | 11.2 | Mz, | 2570.8 | 10.8 | M, | 2585.6 | 11.7 | Pt. |
| 012502 | R Piscium | 2544.8 | 8.7 | Mz, | 2557.8 | 8.3 | Pt, | 2578.8 | 9.2 | M. | | | |
| 013238 | RU Androm. | 2586.7 | *11.5* | M. | | | | | | | | | |
| 013338 | Y Androm. | 2544.8 | 9.9 | Mz, | 2560.9 | 10.0 | $Pe_2$, | 2575.6 | 10.1 | Pt, | 2581.6 | 10.4 | B, |
| | | 2586.7 | 10.5 | M. | | | | | | | | | |
| 014958 | X Cassiop. | 2570.8 | *11.3* | M, | 2581.6 | 12.6 | b. | 2587.6 | 12.1 | M. | | | |
| 015354 | U Persei | 2544.7 | 9.0 | Mz, | 2557.8 | 9.4 | Pt, | 2561.8 | 9.7 | Mz, | 2570.8 | 9.2 | M. |
| 015912 | S Arietis | 2544.8 | *12.9* | Mz, | 2586.7 | *11.6* | M. | | | | | | |
| 021024 | R Arietis | 2545.6 | *12.3* | L, | 2556.6 | 11.6 | L, | 2558.4 | 11.0 | Pe, | 2561.9 | 10.1 | Mz, |
| | | 2584.7 | 10.1 | Ps, | 2586.7 | 9.4 | M. | | | | | | |
| 021143a | W Androm. | 2543.5 | 7.7 | Gi, | 2556.5 | 7.9 | Gi, | 2578.8 | 7.0 | M. | | | |
| *021403* | o Ceti | 2522.2 | 3.6 | Ym, | 2531.4 | 3.6 | Ch, | 2542.6 | 3.2 | L, | 2545.5 | 4.0 | Pe, |
| | | 2545.6 | 3.3 | L, | 2548.5 | 4.1 | Pe, | 2553.5 | 4.2 | Pe, | 2554.2 | 4 9 | Ym, |
| | | 2554.6 | 4.3 | Pe, | 2554.6 | 3.6 | L, | 2554.8 | 4.0 | Ca, | 2557.8 | 4.3 | Pt, |
| | | 2558.5 | 4.4 | Pe, | 2559.2 | 4.5 | Ym, | 2561.2 | 4.6 | Ym, | 2561.8 | 5.0 | Mz, |
| | | 2565.6 | 4.0 | L, | 2567.8 | 4.6 | Ca, | 2584.7 | 6.1 | Ps. | | | |
| 022150 | RR Persei | 2561.9 | *13.4* | Mz, | 2570.6 | *10.4* | Hn. | | | | | | |
| 023133 | R Trianguli | 2570.8 | 6.8 | M, | 2577.8 | 8.0 | Bs, | 2585.6 | 7.2 | Pt. | | | |
| 024356 | W Persei | 2543.3 | 10.1 | Pe, | 2558.4 | 10.2 | Pe, | 2561.8 | 9.2 | Mz, | 2569.8 | 9.6 | M, |
| | | 2573.5 | 8.2 | Hn, | 2574.6 | 9.8 | Pt, | 2584.7 | 10.2 | Ps. | | | |
| *025050* | R Horolog. | 2521.7 | 8.9 | Dw. | | | | | | | | | |
| *025751* | T Horolog. | 2521.7 | *11.5* | Dw. | | | | | | | | | |
| *031401* | X Ceti | 2545.6 | 9.2 | L, | 2559.8 | 9 1 | Pt, | 2562.6 | 9.0 | L. | | | |
| 032043 | Y Persei | 2557.8 | 9.3 | Pt, | 2568.8 | 9.9 | Mz, | 2569.8 | 9.5 | M. | | | |
| 032335 | R Persei | 2569.8 | *11.0* | M. | | | | | | | | | |
| 033362 | U Camelop. | 2569.8 | 7.8 | M. | | | | | | | | | |
| 041619 | T Tauri | 2580.8 | 9.4 | M. | | | | | | | | | |
| 042209 | R Tauri | 2580.9 | *12.0* | M, | 2585.8 | 12.1 | Pt, | 2587.7 | 11.8 | M. | | | |
| 042215 | W Tauri | 2559.8 | 10.5 | Pt, | 2567.8 | 9.7 | M, | 2584 8 | 10.6 | V. | | | |

VARIABLE STAR OBSERVATIONS, August 20 to September 20, 1920—Continued.

| Number Name | J.D. Est. Obs. J.D. Est. Obs. J.D. Est. Obs. J.D. Est. Obs. |
|---|---|
| 042309 S Tauri | 2580.9 *12.0* M. 2587.7 13.4 M. |
| 043065 T Camelop. | 2544.4 9.2 L. 2569.7 10.5 Bs. 2580.8 10.3 M. |
| 043208 RX Tauri | 2580.8 11.3 M. |
| *043263* R Reticuli | 2486.5 9.3 Dw. |
| 043274 X Camelop. | 2569.8 *11.0* Bs. 2576.5 11.1 O. 2580.7 11.2 Pt. 2584.8 11.6 M |
| 044617 V Tauri | 2584.8 10.2 M. |
| *045514* R Leporis | 2544.6 8.5 L. 2559.6 8.1 L. 2585.8 8.8 Pt. |
| *050022* T Leporis | 2585.8 12.0 Pt. |
| 050953 R Aurigae | 2557.8 10.8 Pt. 2561.9 10.3 Mz. 2567.8 10.8 M. 2584.8 *11.4* V. |
| 052034 S Aurigae | 2542.7 10.5 L. 2559.6 10.2 L. 2561.9 10.0 Mz. 2567.8 10.0 M. |
| 052036 W Aurigae | 2542.6 *11.5* L. 2567.8 *11.5* M. |
| *052404* S Orionis | 2567.8 10.4 M. |
| 053005a T Orionis | 2554.6 10.3 L. 2579.8 10.8 Pt. 2584.8 10.0 M. |
| 053068 S Camelop. | 2580.7 10.5 Pt. 2584.8 10.5 M. |
| 053326 RR Tauri | 2584.8 11.7 M. |
| 053531 U Aurigae | 2569.8 11.0 M. 2584.9 *11.0* V. |
| 054319 SU Tauri | 2542.6 9.3 L. 2545.6 9.2 L. 2554.3 9.2 Ym. 2554.6 9.3 L. 2559.2 9.2 Ym. 2559.6 9.3 L. 2579.8 9.5 Pt. 2584.8 9.0 M. 2584.9 9.4 V. 2585.8 9.5 Pt. |
| 054920 U Orionis | 2555.9 7.0 Ca. 2559.8 6.8 Pt. 2570.8 7.0 M. 2575.8 7.3 M. |
| 055353 Z Aurigae | 2567.8 9.5 M. |
| *055686* R Octantis | 2486.5 11.6 Dw. 2521.5 9.3 Dw. 2547.6 9.5 Dw. |
| 060547 SS Aurigae | 2542.6 11.5 L. 2543.6 12.0 L. 2545.6 *12.4* L. 2546.6 *12.4* L. 2549.3 *12.5* Ym. 2554.6 *13.0* L. 2554.3 *13.4* Ym. 2556.6 *12.4* L. 2557.8 *12.6* Pt. 2559.2 *13.5* Ym. 2559.6 *12.4* L. 2559.8 *13.0* Pt. 2561.2 *14.0* Ym. 2565.6 *12.4* Gi. 2579.8 *13.0* Pt. 2580.7 *12.6* Pt. 2580.9 *12.4* M. 2582.7 *12.4* Pt. 2584.9 *11.2* V. 2585.7 *12.6* Pt. 2586.7 *12.4* Pt. |
| 061647 V Aurigae | 2580.9 9.4 M. |
| *061702* V Monoc. | 2580.9 9.0 M. |
| 064030 X Gemin. | 2584.9 *11.2* V. |
| 065111 Y Monoc. | 2584.9 *11.2* V. |
| 070122a R Gemin. | 2579.8 8.6 Pt. 2580.9 8.6 M. |
| 070122b Z Gemin. | 2579.8 12.5 Pt. |
| 070122c TW Gemin. | 2580.9 8.3 M. |
| 072708 S Canis Min. | 2579.8 8.5 Pt. 2580.9 8.4 M. |
| 072811 T Canis Min. | 2580.9 *12.1* M. |
| 073508 U Canis Min. | 2580.9 8.8 M. 2585.8 8.4 Pt. |
| 073723 S Gemin. | 2580.9 *11.5* M. 2584.9 11.3 V. |
| 074323 T Gemin. | 2584.9 *11.2* V. |
| 074922 U Gemin. | 2554.6 *10.9* L. 2559.6 *10.9* L. 2562.6 *11.7* L. 2565.6 *10.0* L. 2579.8 *13.3* Pt. 2580.9 *12.4* M. 2584.9 *11.7* V. 2585.8 *13.3* Pt. |
| 083019 U Cancri | 2584.9 *11.3* V. |
| *090024* S Pyxidis | 2485.4 10.7 Dw. 2486.5 10.4 Dw. |
| 090425 W Cancri | 2584.9 10.2 V. |
| *091868* RW Carinae | 2485.6 *12.9* Tp. 2486.6 13.3 Dw. 2487.6 *12.8* Tp. 2521.5 *13.5*Dw. |
| *092962* R Carinae | 2485.6 8.6 Tp. 2486.6 7.7 Dw. 2487.6 8.3 Tp. 2521.5 5.9 Dw. |
| *094023* RR Hydrae | 2486.6 *13.5* Dw. |
| *094262 l* Carinae | 2485.6 4.1 Tp. 2486.6 4.1 Dw. 2487.6 3.9 Tp. 2521.5 4.3 Dw. 2522.6 4.1 Tp. |

VARIABLE STAR OBSERVATIONS, August 20 to September 20, 1920—Continued.

| Number | Name | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *100661* | S Carinae | 2485.6 | 6.5 | Tp, | 2486.6 | 6.5 | Dw, | 2487.6 | 6.5 | Tp, | 2521.5 | 6.0 | Dw, |
| | | 2522.6 | 5.8 | Tp, | 2545.5 | 6.5 | Dw. | | | | | | |
| 103769 | R Urs. Min. | 2511.1 | *11.0* | Ch, | 2565.8 | *11.0* | Bs, | 2579.8 | *11.5* | Bs, | 2585.6 | 12.5 | Pt. |
| *114441* | X Centauri | 2485.6 | 7.9 | Tp, | 2486.6 | 7.6 | Dw, | 2487.6 | 7.8 | Tp, | 2521.5 | 9.4 | Dw, |
| | | 2522.6 | 9.2 | Tp, | 2545.5 | 10.6 | Dw. | | | | | | |
| 122532 | T Can. Ven. | 2557.7 | 11.0 | Bs, | 2558.7 | *11.5* | Bs, | 2570.6 | 11.1 | Pt. | | | |
| 123160 | T Ursae Maj. | 2510.2 | 9.2 | Ch, | 2518.7 | 8.4 | $Ch_2$, | 2526.1 | 8.3 | Ch, | 2541.6 | 8.2 | Ca, |
| | | 2542.3 | 8.2 | $Pe_2$, | 2550.8 | 8.4 | $Pe_2$, | 2552.6 | 8.5 | Ca, | 2560.6 | 8.7 | Cl, |
| | | 2563.4 | 8.7 | Pe, | 2563.7 | 8.6 | Bs, | 2565.8 | 8.4 | Bs, | 2567.3 | 8.7 | Pe, |
| | | 2568.5 | 8.8 | K, | 2568.6 | 8.7 | Cl, | 2570.6 | 8.5 | Gd, | 2570.6 | 8.8 | Pt, |
| | | 2577.8 | 8.1 | $Bs_2$, | 2580.6 | 9.0 | Ya, | 2582.6 | 9.2 | Wl, | 2585.5 | 9.2 | Gd, |
| | | 2587.5 | 9.2 | Pi. | | | | | | | | | |
| 123307 | R Virginis | 2556.7 | 6.4 | Bs. | | | | | | | | | |
| 123459 | RS Urs. Maj. | 2510.2 | *11.0* | Ch, | 2541.3 | *12.6* | Pe, | 2542.0 | *13.4* | Ym, | 2578.7 | *11.5* | Bs. |
| 123961 | S Urs. Maj. | 2510.2 | 9.2 | Ch, | 2521.2 | 9.4 | Ch, | 2539.4 | 10.6 | L, | 2542.3 | 10.8 | $Pe_2$, |
| | | 2547.4 | 10.9 | L, | 2550.8 | 10.8 | $Pe_2$, | 2555.3 | 11.3 | L, | 2565.7 | *11.2* | Bs, |
| | | 2568.5 | *10.0* | K, | 2570.6 | 11.6 | Gd, | 2570.6 | 11.5 | Pt, | 2574.6 | *10.8* | V, |
| | | 2580.6 | *11.1* | Ya, | 2585.5 | 11.6 | Gd, | 2587.5 | 11.0 | Pi. | | | |
| 124204 | RU Virginis | 2555.7 | 9.4 | Bs. | | | | | | | | | |
| *131283* | U Octantis | 2485.6 | 9.8 | Tp, | 2487.6 | 9.9 | Tp, | 2521.5 | 8.4 | Dw, | 2522.6 | 8.6 | Tp, |
| | | 2545.6 | 8.9 | Dw. | | | | | | | | | |
| *132422* | R Hydrae | 2509.1 | 7.8 | Ch, | 2521.5 | 7.4 | Dw, | 2545.5 | 7.1 | Dw. | | | |
| 133273 | T Urs. Min. | 2587.5 | 12.0 | Pi. | | | | | | | | | |
| *133633* | T Centauri | 2485.6 | 7.4 | Tp, | 2487.6 | 7.2 | Tp, | 2521.5 | 6.3 | Dw, | 2522.6 | 6.1 | Tp, |
| | | 2545.5 | 6.9 | Dw. | | | | | | | | | |
| *134236* | RT Centauri | 2485.6 | 9.9 | Tp, | 2487.6 | 10.1 | Tp, | 2521.5 | 11.6 | Dw, | 2522.6 | 11.8 | Tp, |
| | | 2545.5 | 11.9 | Dw. | | | | | | | | | |
| 134440 | R Can. Ven. | 2544.7 | 9.3 | Mz, | 2549.4 | 8.6 | $Pe_2$, | 2559.2 | 7.8 | $Bs_2$, | 2569.6 | 9.0 | Ya, |
| | | 2570.6 | 9.3 | Pt, | 2573.7 | 7.2 | Bs, | 2579.5 | 9.6 | Gd. | | | |
| *134677* | T Apodis | 2485.6 | *13.6* | Tp, | 2487.6 | *13.5* | Tp, | 2521.5 | 12.9 | Dw, | 2522.6 | 12.5 | Tp, |
| | | 2545.6 | 10.3 | Dw. | | | | | | | | | |
| 140113 | Z Bootis | 2570.6 | 9.3 | B. | | | | | | | | | |
| *140528* | RU Hydrae | 2485.6 | 12.5 | Tp, | 2487.6 | 12.6 | Tp, | 2521.5 | 8.9 | Dw, | 2522.6 | 9.0 | Tp, |
| | | 2545.6 | 9.0 | Dw. | | | | | | | | | |
| *140959* | R Centauri | 2485.6 | 7.6 | Tp, | 2487.6 | 7.6 | Tp, | 2521.5 | 7.5 | Dw, | 2522.6 | 7.4 | Tp, |
| | | 2545.6 | 7.1 | Dw, | 2547.6 | 7.1 | Dw. | | | | | | |
| 141567 | U Urs. Min. | 2564.6 | 9.2 | B, | 2575.6 | 10.1 | Pt, | 2576.6 | 9.8 | Ya, | 2587.5 | 10.4 | Pi. |
| 141954 | S Bootis | 2542.0 | 11.9 | Ym, | 2547.4 | 12.2 | L, | 2548.3 | 11.3 | Pe, | 2553.3 | *12.0* | Pe, |
| | | 2566.8 | *11.5* | Bs, | 2570.6 | 13.4 | Pt, | 2571.6 | 13.3 | B, | 2579.8 | *11.5* | Bs. |
| 142539 | V Bootis | 2541.4 | 10.7 | L, | 2549.4 | 9.6 | Pe, | 2555.4 | 9.4 | L, | 2556.6 | 9.0 | Ca, |
| | | 2558.3 | 9.2 | L, | 2568.6 | 8.9 | Po, | 2569.5 | 8.7 | K, | 2572.6 | 8.7 | Su, |
| | | 2574.6 | 8.5 | Pt, | 2584.6 | 7.3 | Ps. | | | | | | |
| 142584 | R Camelop. | 2556.5 | *12.0* | Cl, | 2571.6 | 10.6 | B, | 2576.5 | 10.8 | O. | | | |
| 143227 | R Bootis | 2544.4 | 10.2 | Pe, | 2549.0 | 9.7 | $Pe_2$, | 2558.4 | 9.4 | Pe, | 2564.6 | 8.7 | B, |
| | | 2566.7 | 9.5 | Bs, | 2572.5 | 8.6 | Ya, | 2572.6 | 8.6 | Su, | 2574.6 | 8.6 | Pt, |
| | | 2578.0 | 8.6 | $Gd_2$, | 2579.8 | 8.8 | Bs. | | | | | | |
| 144918 | U Bootis | 2546.4 | 10.0 | Gi, | 2550.3 | 10.5 | Gi, | 2574.6 | *11.0* | V. | | | |
| *145254* | Y Lupi | 2485.6 | *13.8* | Tp, | 2521.5 | *14.2* | Dw, | 2547.6 | *13.7* | Dw. | | | |
| *150605* | Y Librae | 2575.6 | 9.2 | B. | | | | | | | | | |
| 151432 | U Cor. Bor. | 2570.5 | 8.5 | Jd. | | | | | | | | | |
| *151520* | S Librae | 2510.1 | 11.5 | Ch, | 2542.3 | 10.2 | L, | 2549.3 | 10.1 | L. | | | |
| 151714 | S Serpentis | 2541.4 | 8.0 | L, | 2549.4 | 8.0 | L, | 2558.3 | 8.0 | L, | 2558.3 | 8.4 | Bc, |
| | | 2570.6 | 8.7 | B. | | | | | | | | | |

VARIABLE STAR OBSERVATIONS, August 20 to September 20, 1920—Continued.

| Number | Name | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 151731 | S Cor. Bor. | 2510.2 | *11.0* | Ch, | 2568.0 | 11.9 | Ym, | 2570.5 | *10.3* | Jd, | 2585.6 | 12.6 | Pt. |
| *151822* | RS Librae | 2542.3 | 8.3 | L, | 2549.4 | 8.5 | L. | | | | | | |
| *152714* | RU Librae | 2548.3 | 8.8 | Pe, | 2575.6 | 8.1 | B. | | | | | | |
| *152849* | R Normae | 2485.6 | 8.2 | Tp, | 2487.6 | 8.3 | Tp, | 2521.5 | 9.2 | Dw, | 2522.6 | 9.1 | Tp, |
| | | 2547.6 | 10.4 | Dw. | | | | | | | | | |
| 153378 | S Urs. Min. | 2544.7 | 8.7 | Ca, | 2554.7 | *8.2* | Ga, | 2559.8 | 8.5 | Ca, | 2566.7 | 8.8 | Bs, |
| | | 2569.5 | 8.3 | K, | 2570.5 | 8.6 | Gd, | 2572.6 | 8.4 | Su, | 2574.6 | 8.3 | V, |
| | | 2574.6 | 8.0 | Pt, | 2576.7 | 8.4 | Bs, | 2585.6 | 8.3 | Gd, | 2587.6 | 8.6 | Pi. |
| *153654* | T Normae | 2485.6 | 9.6 | Tp, | 2487.6 | 8.9 | Tp, | 2521.5 | 8.3 | Dw, | 2522.6 | 8.0 | Tp, |
| | | 2547.6 | 9.2 | Dw. | | | | | | | | | |
| 154428 | R Cor. Bor. | 2510.1 | 6.5 | Ch, | 2513.2 | 6.6 | Ch, | 2521.2 | 6.5 | Ch, | 2526.6 | 6.8 | K, |
| | | 2531.5 | 6.7 | K, | 2532.5 | 6.6 | K, | 2533.6 | 6.6 | K, | 2538.7 | 6.6 | Ga, |
| | | 2539.4 | 6.3 | L, | 2539.7 | 6.7 | Lc, | 2539.4 | 6.5 | Gi, | 2540.6 | 6.9 | Cn, |
| | | 2541.3 | 6.4 | Pe, | 2541.3 | 6.4 | L, | 2541.6 | 6.4 | Ca, | 2544.3 | 6.5 | Gi, |
| | | 2544.4 | 6.4 | Pe, | 2544.6 | 6.4 | Ca, | 2545.7 | 6.6 | Lc, | 2546.6 | 6.0 | Hn, |
| | | 2547.4 | 6.3 | L, | 2548.4 | 6.6 | Pe, | 2549.3 | 6.6 | Gi, | 2549.3 | 6.3 | L, |
| | | 2551.6 | 6.6 | Ca, | 2552.7 | 6.6 | Mu, | 2553.7 | 6.8 | Bs, | 2553.7 | 6.8 | Ga, |
| | | 2554.1 | 7.1 | Ym, | 2554.3 | 6.4 | L, | 2554.7 | 6.7 | Mu, | 2554.7 | 6.6 | Bs, |
| | | 2555.3 | 6.6 | Gi, | 2555.3 | 6.4 | L, | 2555.4 | 6.5 | Be, | 2556.0 | 6.8 | Ym, |
| | | 2556.3 | 6.3 | L, | 2556.5 | 6.1 | Cl, | 2556.6 | 6.6 | Ca, | 2557.3 | 6.4 | L, |
| | | 2557.7 | 6.7 | Mu, | 2558.3 | 6.5 | Be, | 2558.3 | 6.4 | L, | 2558.5 | 6.4 | Cl, |
| | | 2559.7 | 6.5 | Ca, | 2559.8 | 6.6 | Bs, | 2560.6 | 6.1 | Cl, | 2561.7 | 6.4 | Bs, |
| | | 2562.3 | 6.4 | Be, | 2562.3 | 6.3 | L, | 2563.3 | 6.4 | Be, | 2563.4 | 6.4 | Gi, |
| | | 2563.6 | 6.2 | Ya, | 2563.7 | 6.2 | Bs, | 2564.4 | 6.3 | L, | 2565.3 | 6.2 | L, |
| | | 2565.3 | 6.2 | Be, | 2565.8 | 6.0 | Bs, | 2566.0 | 6.5 | Ym, | 2566.7 | 5.9 | Bs, |
| | | 2567.3 | 6.3 | L, | 2567.6 | 6.2 | Pt, | 2567.8 | 5.7 | Bs, | 2568.0 | 7.0 | Ym, |
| | | 2568.6 | 6.4 | K, | 2568.6 | 6.0 | Cl, | 2568.6 | 6.9 | Gd, | 2568.6 | 6.0 | Hn, |
| | | 2568.7 | 5.6 | Bs, | 2569.5 | 6.4 | K, | 2569.5 | 6.8 | Jd, | 2569.6 | 6.2 | Cl, |
| | | 2569.6 | 6.2 | Pt, | 2569.7 | 6.3 | Mu, | 2569.8 | 5.9 | Bs, | 2570.5 | 6.5 | K, |
| | | 2570.5 | 6.7 | Cl, | 2570.7 | 6.2 | Mu, | 2571.5 | 6.5 | Hn, | 2571.5 | 6.8 | Cl, |
| | | 2572.5 | 6.5 | K, | 2572.5 | 6.7 | Cl, | 2572.6 | 6.5 | Bn, | 2572.6 | 6.5 | Su. |
| | | 2572.7 | 6.0 | Bs, | 2573.5 | 6.1 | O, | 2573.5 | 6.8 | Cl, | 2573.5 | 6.2 | Mo, |
| | | 2573.6 | 6.5 | K, | 2573.7 | 6.3 | Mu, | 2574.6 | 6.1 | Pt, | 2574.6 | 6.4 | V, |
| | | 2576.5 | 6.1 | O, | 2576.5 | 6.8 | Cl, | 2576.5 | 6.7 | K, | 2576.6 | 6.9 | Wl, |
| | | 2576.7 | 6.3 | Mu, | 2576.7 | 5.9 | Bs, | 2578.7 | 6.2 | Bs, | 2579.5 | 6.3 | K, |
| | | 2579.5 | 6.1 | Cl, | 2579.6 | 6.2 | O, | 2579.7 | 6.5 | Mu, | 2580.7 | 6.1 | Pt, |
| | | 2581.5 | 6.2 | O, | 2582.5 | 6.5 | Hn, | 2582.6 | 6.1 | Pt, | 2582.6 | 6.8 | Wl, |
| | | 2582.7 | 6.5 | Mu, | 2583.6 | 6.8 | Cl, | 2583.7 | 6.0 | Bs, | 2584.5 | 6.5 | K, |
| | | 2584.5 | 6.2 | O, | 2584.5 | 6.1 | Cl, | 2584.6 | 5.9 | Ps, | 2585.5 | 6.3 | Cl, |
| | | 2585 6 | 6.2 | Pi, | 2585.6 | 6.4 | Gd, | 2586.6 | 6.3 | Pt, | 2587.5 | 6.3 | Mo. |
| 154615 | R Serpentis | 2570.6 | 13.0 | B. | | | | | | | | | |
| 154639 | V Cor. Bor. | 2558.6 | 9.7 | B, | 2575.6 | 10.8 | Pt. | | | | | | |
| *154736* | R Lupi | 2521.6 | 11.8 | Dw, | 2547.6 | 13.2 | Dw. | | | | | | |
| *155018* | RR Librae | 2542.3 | *12.7* | L, | 2549.3 | *12.7* | L, | 2571.6 | 13.8 | B. | | | |
| 155229 | Z Cor. Bor. | 2542.0 | *13.2* | Ym, | 2568.0 | *12.5* | Ym. | | | | | | |
| *160021* | Z Scorpii | 2544.3 | *11.7* | L. | | | | | | | | | |
| 160118 | R Herculis | 2571.6 | 9.8 | B, | 2586.5 | *10.7* | Pi. | | | | | | |
| 160210 | U Serpentis | 2532.6 | 10.5 | K, | 2544.1 | 10.0 | Ym, | 2553.7 | 11.0 | Bs, | 2566.7 | 10.5 | Bs, |
| | | 2569.5 | 8.3 | K, | 2569.6 | 8.1 | B, | 2570.8 | 10.2 | Bs, | 2574.6 | 8.5 | Pt, |
| | | 2586.5 | 8.0 | Pi. | | | | | | | | | |
| 160625 | RU Herculis | 2568.6 | 9.2 | Ya, | 2569.6 | 9.2 | B, | 2570.6 | 9.8 | Po, | 2574.6 | 9.7 | Pt, |
| | | 2576.5 | 10.0 | O, | 2586.5 | 10.5 | Pi. | | | | | | |
| *161122a* | R Scorpii | 2544 3 | 9.4 | Pe, | 2569.5 | 9.8 | Gd, | 2570.6 | 10.3 | Pt. | | | |
| *161122b* | S Scorpii | 2544.3 | *11.6* | Pe. | | | | | | | | | |
| *161122c* | T Scorpii | 2569.5 | 10.4 | Gd, | 2570.6 | 10.9 | Pt. | | | | | | |
| 161138 | W Cor. Bor. | 2556.6 | *11.6* | Cl, | 2569.6 | 11.0 | Ya. | | | | | | |

VARIABLE STAR OBSERVATIONS, August 20 to September 20, 1920—Continued.

| Number | Name | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *161607* | W Ophiuchi | 2544.1 | 11.8 | Ym, | 2547.4 | 11.8 | L. | | | | | | |
| *162112* | V Ophiuchi | 2568.6 | 9.6 | B, | 2572.5 | 10.9 | Cl. | | | | | | |
| 162119 | U Herculis | 2544.7 | 10.9 | Ca, | 2548.4 | 11.7 | Pe, | 2556.7 | 10.9 | Ca, | 2568.8 | *11.4* | Bs, |
| | | 2574.6 | *10.9* | V, | 2582.6 | 11.6 | Pt. | | | | | | |
| *162319* | Y Scorpii | 2541.4 | *13.5* | Gi, | 2554.3 | 13.2 | Gi. | | | | | | |
| 162807 | SS Herculis | 2558.6 | 8.9 | B. | | | | | | | | | |
| 163137 | W Herculis | 2514.2 | *11.0* | Ch, | 2575.6 | 11.0 | Pt, | 2585.6 | 10.5 | Pi. | | | |
| 163172 | R Urs. Min. | 2564.6 | 9.2 | B. | | | | | | | | | |
| 163266 | R Draconis | 2511.1 | 10.4 | Ch, | 2567.8 | *11.5* | Bs, | 2578.6 | 13.2 | B, | 2587.6 | *12.0* | Pi. |
| 164715 | S Herculis | 2539.5 | 9.6 | Gi, | 2549.4 | 10.1 | Gi, | 2556.6 | 9.6 | B, | 2582.6 | 11.2 | Pt, |
| | | 2585.6 | *10.5* | Pi. | | | | | | | | | |
| *164844* | RS Scorpii | 2485.6 | 11.7 | Tp, | 2487.6 | 11.5 | Tp, | 2521.6 | 11.5 | Dw, | | | |
| | | 2522.6 | 11.4 | Tp, | 2547.6 | 10.9 | Dw. | | | | | | |
| *165030* | RR Scorpii | 2485.6 | 8.4 | Tp, | 2487.6 | 7.9 | Tp, | 2521.6 | 7.1 | Dw, | 2522.6 | 6.8 | Tp, |
| | | 2547.6 | 6.8 | Dw. | | | | | | | | | |
| 165631 | RV Herculis | 2531.6 | *11.2* | K, | 2548.4 | 12.2 | Pe, | 2574.6 | 9.1 | V, | 2574.6 | 9.8 | Pt, |
| | | 2575.6 | 10.0 | Gd, | 2577.6 | 10.2 | B, | 2585.6 | 10.5 | Pi, | 2586.6 | 10.2 | M. |
| *170215* | R Ophiuchi | 2510.1 | 9.1 | Ch, | 2517.1 | 9.3 | Ch, | 2545.4 | 10.5 | Pe, | 2556.7 | *10.7* | Ca, |
| | | 2568.7 | 10.8 | Bs, | 2569.6 | *9.8* | Ya, | 2578.7 | *11.5* | Bs. | | | |
| 170627 | RT Herculis | 2556.7 | 12.4 | B. | | | | | | | | | |
| 171401 | Z Ophiuchi | 2540.4 | 11.6 | Gi, | 2550.4 | 11.8 | Gi, | 2554.7 | 11.7 | B, | 2575.6 | 12.0 | Pt. |
| 171723 | RS Herculis | 2532.6 | 8.1 | K, | 2549.3 | 9.3 | Pe, | 2558.6 | 8.7 | B, | 2568.6 | 9.3 | Ya, |
| | | 2568.8 | 9.3 | Mz, | 2570.5 | 9.4 | K, | 2574.6 | 9.4 | Pt, | 2580.6 | 9.7 | Gd, |
| | | 2580.6 | 9.5 | Wl, | 2585.6 | 10.3 | Pi, | 2586.6 | 10.9 | M. | | | |
| *172486* | S Octantis | 2485.6 | *13.0* | Tp, | 2487.6 | *13.0* | Tp, | 2521.6 | 12.9 | Dw, | | | |
| | | 2522.6 | 13.0 | Tp, | 2547.6 | 12.1 | Dw. | | | | | | |
| 172809 | RU Ophiuchi | 2575.6 | 11.7 | Pt. | | | | | | | | | |
| 175111 | RT Ophiuchi | 2556.6 | 8.8 | Cl, | 2571.5 | 9.5 | Cl, | 2577.6 | 10.4 | B, | 2582.6 | 10.6 | Pt. |
| 175458a | T Draconis | 2538.4 | 10.4 | Gi, | 2549.5 | 10.5 | Gi, | 2559.4 | 10.7 | Gi, | 2573.5 | 10.3 | Gi. |
| 175519 | RY Herculis | 2513.1 | *11.7* | Ch, | 2548.4 | *12.9* | Pe, | 2582.6 | 13.1 | Pt. | | | |
| 180363 | R Pavonis | 2487.6 | 8.3 | Tp, | 2521.6 | 10.6 | Dw. | | | | | | |
| 180531 | T Herculis | 2505.2 | 8.5 | Ch, | 2513.1 | 8.1 | Ch, | 2526.1 | 7.6 | Ch, | 2539.4 | 7.8 | L, |
| | | 2544.7 | 7.6 | Ca, | 2544.9 | 7.5 | Mz, | 2546.6 | 7.6 | L, | 2549.6 | 7.8 | L, |
| | | 2553.7 | 8.5 | Ga, | 2556.6 | 8.2 | L, | 2559.8 | 8.3 | Ca, | 2568.6 | 9.1 | Ya, |
| | | 2568.8 | 9.2 | Mz, | 2570.7 | 8.5 | Bs, | 2572.6 | 9.4 | Su, | 2575.6 | 10.3 | Pt, |
| | | 2577.7 | 8.4 | Bs, | 2584.5 | 11.0 | O, | 2584.6 | 11.0 | Ps, | 2585.6 | 11.0 | Pi, |
| | | 2586.6 | 11.4 | M. | | | | | | | | | |
| 180911 | Nova Ophiu.4 | 2539.4 | 10.8 | L, | 2540.4 | 11.4 | Gi, | 2550.4 | 11.3 | $Gi_2$, | 2554.3 | 10.8 | L, |
| | | 2570.6 | 11.0 | $Pt_3$, | 2577.6 | 11.2 | B, | 2580.6 | *11.1* | V, | 2580.7 | 10.9 | Pt. |
| 181103 | RY Ophiuchi | 2544.4 | 12.2 | Gi, | 2556.3 | 12.5 | Gi, | 2575.6 | 13.1 | B. | | | |
| 181136 | W Lyrae | 2542.6 | 10.4 | L, | 2544.9 | 11.8 | Mz, | 2570.6 | *11.7* | Ya, | 2584.6 | *11.7* | Ps, |
| | | 2585.5 | *12.4* | Pi. | | | | | | | | | |
| *182133* | RV Sagittarii | 2485.6 | *13.6* | Tp, | 2487.6 | *13.5* | Tp, | 2521.6 | 12.5 | Dw, | 2522.6 | 12.3 | Tp. |
| 182224 | SV Herculis | 2542.4 | *12.7* | L, | 2581.6 | *13.7* | B. | | | | | | |
| 183308 | X Ophiuchi | 2541.4 | 7.7 | L, | 2568.6 | 8.4 | Ya, | 2570.6 | 8.2 | B, | 2570.6 | 8.4 | Cl, |
| | | 2584.5 | 9.0 | O. | | | | | | | | | |
| *184205* | R Scuti | 2514.2 | 6.8 | Ch, | 2517.2 | 6.9 | Ch, | 2539.4 | 5.9 | L, | 2539.5 | 6.3 | Gi, |
| | | 2541.3 | 5.8 | Pe, | 2541.7 | 5.9 | Ca, | 2543.3 | 5.9 | Pe, | 2544.6 | 5.9 | Ca, |
| | | 2545.4 | 5.8 | Gi, | 2546.4 | 5.8 | Pe, | 2546.6 | 5.8 | L, | 2546.6 | 6.1 | Hn, |
| | | 2549.4 | 5.5 | L, | 2551.7 | 5.7 | Ca, | 2552.7 | 5.8 | Mu, | 2554.3 | 5.3 | L, |
| | | 2554.3 | 5.6 | Pe, | 2554.7 | 5.7 | Mu, | 2555.3 | 5.5 | Be, | 2556.3 | 5.2 | L, |
| | | 2556.3 | 5.3 | Gi, | 2556.7 | 5.2 | Ca, | 2557.4 | 5.4 | Be, | 2557.7 | 5.7 | Mu, |
| | | 2558.3 | 5.4 | Be, | 2558.3 | 5.3 | L, | 2558.4 | 5.7 | Pe, | 2558.6 | 5.7 | Cl. |

VARIABLE STAR OBSERVATIONS, August 20 to September 20, 1920—Continued.

| Number | Name | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *184205* | R Scuti | 2559.4 | 5.4 | Be, | 2559.7 | 5.2 | Ca, | 2559.8 | 5.5 | Pt, | 2560.6 | 5.7 | Cl. |
| | | 2562.3 | 5.1 | L, | 2563.6 | 5.4 | Ya, | 2565.3 | 5.0 | L, | 2566.3 | 5.0 | Gi, |
| | | 2566.6 | 5.1 | Pt, | 2567.3 | 5.1 | Be, | 2567.3 | 5.1 | L, | 2567.6 | 5.2 | Pt, |
| | | 2567.7 | 5.5 | Bs, | 2568.5 | 6.0 | Hn, | 2568.5 | 5.4 | K, | 2568.5 | 5.5 | Cl, |
| | | 2568.6 | 5.8 | Gd, | 2568.6 | 5.0 | Pt, | 2568.8 | 5.3 | Bs, | 2569.5 | 5.4 | K, |
| | | 2569.6 | 5.0 | Pt, | 2569.6 | 6.1 | Hn, | 2569.7 | 5.8 | Mu, | 2570.5 | 5.5 | K, |
| | | 2570.7 | 5.4 | Mu, | 2571.5 | 4.8 | Cl, | 2572.5 | 5.5 | K, | 2572.5 | 5.2 | Cl, |
| | | 2572.6 | 5.5 | Bn, | 2572.6 | 5.2 | Su, | 2573.5 | 5.1 | Mo, | 2573.5 | 4.7 | Cl, |
| | | 2573.6 | 5.6 | K, | 2573.6 | 5.3 | O, | 2573.7 | 5.2 | Bs, | 2573.7 | 5.2 | Mu, |
| | | 2574.6 | 5.5 | Pt, | 2575.6 | 5.5 | Pt, | 2576.5 | 4.7 | Cl, | 2576.5 | 5.0 | K, |
| | | 2576.5 | 5.5 | O, | 2576.7 | 5.2 | Mu, | 2577.6 | 5.5 | Pt, | 2577.8 | 4.9 | Bs, |
| | | 2578.6 | 5.7 | Pt, | 2578.7 | 4.8 | Bs, | 2579.5 | 5.3 | Cl. | 2579.5 | 5.3 | K. |
| | | 2579.6 | 5.5 | O, | 2579.7 | 5.4 | Mu, | 2580.6 | 5.5 | Su, | 2580.7 | 5.4 | Pt, |
| | | 2581.5 | 5.6 | O, | 2582.6 | 5.4 | Pt, | 2582.7 | 5.0 | Mu, | 2583.6 | 5.6 | Cl. |
| | | 2583.7 | 5.0 | Bs, | 2584.5 | 5.4 | K, | 2584.5 | 5.7 | Cl, | 2584.5 | 5.8 | O, |
| | | 2584.6 | 5.0 | Ps, | 2585.5 | 5.7 | Cl, | 2585.5 | 5.5 | Gd, | 2585.6 | 5.5 | Pi, |
| | | 2585.6 | 5.7 | Wl, | 2586.5 | 5.4 | Pt, | 2586.6 | 5.0 | M, | 2587.5 | 5.4 | Mo. |
| 184300 | Nova Aquil.3 | 2513.2 | 8.4 | Ch, | 2517.2 | 8.6 | Ch, | 2526.1 | 8.6 | Ch, | 2532.6 | 8.5 | $K_3$, |
| | | 2540.0 | 8.1 | Ym, | 2541.4 | 9.1 | $Gi_2$, | 2541.4 | 8.5 | L, | 2543.3 | 8.2 | Pe, |
| | | 2548.1 | 8.4 | $Ym_2$, | 2550.4 | 9.2 | $Gi_2$, | 2550.8 | 8.6 | $L_2$, | 2554.3 | 8.4 | Pe, |
| | | 2556.0 | 8.1 | Ym, | 2556.5 | 9.1 | Cl, | 2559.5 | 9.2 | Gi, | 2561.5 | 9.0 | Ro, |
| | | 2563.6 | 8.7 | Ya, | 2566.0 | 8.5 | Ym, | 2568.6 | 8.9 | B, | 2569.2 | 9.0 | $Ro_2$, |
| | | 2570.6 | 8.7 | $Pt_3$, | 2571.5 | 8.8 | Cl, | 2571.9 | 8.6 | $K_3$, | 2580.1 | 9.0 | $Ro_3$, |
| | | 2580.2 | 8.7 | $Cl_3$, | 2580.2 | 8.7 | $K_3$, | 2580.6 | 9.3 | V, | 2582.6 | 8.7 | Pt, |
| | | 2585.5 | 8.8 | Cl, | 2586.6 | 8.0 | M. | | | | | | |
| 184929 | Nova Lyrae 1 | 2538.4 | 12.4 | Gi, | 2545.4 | 12.4 | Gi, | 2554.4 | 12.6 | Gi, | 2554.6 | 12.5 | L. |
| 185032 | RX Lyrae | 2587.6 | *15.0* | M. | | | | | | | | | |
| 190108 | R Aquilae | 2554.6 | 9.6 | B, | 2575.6 | 8.6 | Pt. | | | | | | |
| *190818* | RX Sagittarii | 2556.6 | *13.3* | B. | | | | | | | | | |
| *190819a* | RW Sagittarii | 2556.6 | 10.0 | B. | | | | | | | | | |
| 190967 | U Draconis | 2584.6 | *10.3* | Ps. | | | | | | | | | |
| *191019* | R Sagittarii | 2572.7 | *11.5* | Mz, | 2578.6 | 11.6 | B. | | | | | | |
| *191033* | RY Sagittarii | 2485.6 | 6.8 | Tp, | 2487.6 | 6.9 | Tp, | 2521.6 | 6.6 | Dw, | 2522.6 | .6.9 | Tp, |
| | | 2539.4 | 6.3 | L, | 2547.4 | 6.4 | L, | 2547.6 | 7.1 | Dw, | 2556.3 | 7.0 | L, |
| | | 2564.3 | 6.3 | L, | 2567.6 | 6.3 | Pt, | 2569.6 | 6.4 | Pt. | 2570.6 | 6.2 | Pt, |
| | | 2574.6 | 6.1 | Pt, | 2575.6 | 6.3 | Pt. | 2578.6 | 6.2 | Pt. | 2582.6 | 6.1 | Pt, |
| | | 2585.6 | 6.2 | Pt. | | | | | | | | | |
| *191124* | TY Sagittarii | 2521.6 | 11.4 | Dw. | | | | | | | | | |
| *191319* | S Sagittarii | 2541.4 | *13.1* | Gi, | 2556.4 | *13.2* | Gi. | | | | | | |
| *191321* | Z Sagittarii | 2544.4 | 9.4 | Gi, | 2556.4 | 9.5 | Gi. | | | | | | |
| 191637 | U Lyrae | 2557.8 | 10.6 | Pt, | 2575.7 | 8.8 | Hl, | 2586.7 | 10.6 | M. | | | |
| 192928 | TY Cygni | 2586.7 | *11.9* | M, | 2587.6 | 12.7 | M. | | | | | | |
| 193449 | R Cygni | 2511.2 | *11.8* | Ch, | 2555.9 | *10.9* | Ca, | 2560.7 | *11.3* | Po, | 2587.7 | 13.7 | M. |
| 193509 | RV Aquilae | 2575.6 | 12.0 | Pt. | | | | | | | | | |
| 193732 | TT Cygni | 2580.6 | 8.2 | Ya. | | | | | | | | | |
| *193972* | T Pavonis | 2485.6 | *13.4* | Tp, | 2521.6 | 12.2 | Dw, | 2522.6 | 12.5 | Tp. | | | |
| 194048 | RT Cygni | 2505.2 | 7.5 | Ch, | 2511.2 | 7.3 | Ch. | 2529.1 | 7.1 | Ch, | 2539.4 | 7.9 | Gi, |
| | | 2549.5 | 7.7 | Gi, | 2555.9 | 8.0 | Ca, | 2559.4 | 8.1 | Gi, | 2564.6 | 8.4 | Ya, |
| | | 2578.7 | 9.0 | Pt, | 2580.6 | 9.1 | V, | 2584.8 | 9.6 | M, | 2585.5 | 9.5 | Pi. |
| 194348 | TU Cygni | 2564.6 | 10.0 | Ya, | 2579.7 | 9.5 | Pt, | 2580.6 | 9.1 | V, | 2584.8 | 9.0 | M, |
| | | 2585.5 | 9.6 | Pi. | | | | | | | | | |
| 194604 | X Aquilae | 2554.7 | *13.5* | B, | 2571.5 | *12.9* | Cl, | 2587.6 | 13.3 | M. | | | |
| 194632 | $\chi$ Cygni | 2504.2 | 5.4 | Ch, | 2510.2 | 5.2 | Ch, | 2540.6 | 7.3 | Cn, | 2542.0 | 6.3 | $Ym_2$, |
| | | 2543.0 | 5.8 | $Pe_3$, | 2550.1 | 6.4 | $Ym_4$, | 2550.3 | 6.4 | $Pe_3$, | 2557.6 | 6.5 | B, |
| | | 2557.8 | 7.0 | Pt, | 2559.7 | 7.0 | $Ym_3$, | 2560.4 | 6.8 | $Pe_2$, | 2564.6 | 7.0 | Ya, |

VARIABLE STAR OBSERVATIONS, August 20 to September 20, 1920—Continued.

| Number | Name | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 194632 | χ Cygni | 2566.9 | 7.4 | Ym$_2$, | 2569.8 | 7.0 | M, | 2573.1 | 7.6 | K$_2$, | 2573.5 | 8.0 | O, |
| | | 2577.5 | 7.1 | B, | 2580.2 | 7.7 | Cl$_2$, | 2580.2 | 7.7 | K$_2$, | 2580.6 | 7.5 | V, |
| | | 2585.5 | 7.7 | Cl, | 2585.6 | 8.1 | Pi. | | | | | | |
| *194659* | S Pavonis | 2485.6 | 9.7 | Tp, | 2487.6 | 9.5 | Tp, | 2521.6 | 8.7 | Dw, | 2522.6 | 8.4 | Tp. |
| *194929* | RR Sagittarii | 2485.6 | 8.9 | Tp, | 2487.6 | 8.9 | Tp, | 2521.6 | 10.9 | Dw, | 2522.6 | 10.9 | Tp. |
| 195116 | S Sagittae | 2552.7 | 5.3 | Mu, | 2554.7 | 5.3 | Mu, | 2557.7 | 6.1 | Mu, | 2569.7 | 5.5 | Mu, |
| | | 2570.7 | 5.4 | Mu, | 2572.6 | 5.5 | Bn, | 2573.7 | 6.2 | Mu, | 2576.7 | 6.0 | Mu, |
| | | 2579.7 | 5.4 | Mu, | 2582.7 | 6.1 | Mu. | | | | | | |
| *195202* | RR Aquilae | 2554.6 | 12.2 | B. | | | | | | | | | |
| *195308* | RS Aquilae | 2554.6 | 11.8 | B. | | | | | | | | | |
| 195653 | Nova Cygni 3 | 2558.4 | 3.4 | Lt, | 2559.3 | 2.8 | Lt, | 2559.4 | 2.8 | Gi, | 2559.5 | 2.8 | Lt, |
| | | 2559.6 | 2.3 | Su, | 2559.8 | 2.5 | Pt, | 2560.3 | 1.9 | Be, | 2560.3 | 1.8 | L, |
| | | 2560.3 | 1.7 | Ym, | 2560.4 | 2.2 | Gi, | 2560.4 | 2.2 | Lt, | 2560.5 | 2.3 | Ro, |
| | | 2560.6 | 2.2 | Wt, | 2560.6 | 2.2 | Su, | 2560.6 | 2.0 | O, | 2560.6 | 2.2 | Pt, |
| | | 2560.6 | 2.1 | Wo, | 2560.8 | 1.8 | M, | 2561.0 | 1.7 | Ym, | 2561.0 | 1.7 | Fk, |
| | | 2561.1 | 2.1 | Fk, | 2561.2 | 2.2 | Fk, | 2561.3 | 1.8 | Ym, | 2561.3 | 1.8 | Lt, |
| | | 2561.5 | 2.1 | Ro, | 2561.5 | 2.1 | Cl, | 2561.5 | 2.4 | K, | 2561.6 | 2.6 | Pi, |
| | | 2561.6 | 2.0 | Ya, | 2561.7 | 2.3 | M, | 2561.7 | 1.8 | Mz, | 2561.7 | 2.0 | Pt, |
| | | 2561.7 | 2.0 | Po, | 2561.8 | 2.2 | Ad, | 2562.0 | 1.6 | Mz, | 2562.0 | 1.8 | Ym, |
| | | 2562.0 | 2.0 | Fk, | 2562.1 | 1.8 | Ym, | 2562.2 | 1.9 | Ym, | 2562.3 | 2.3 | Be, |
| | | 2562.3 | 2.2 | L, | 2562.3 | 2.2 | Pe, | 2562.4 | 2.2 | Gi, | 2562.5 | 1.9 | Hn, |
| | | 2562.5 | 2.3 | Cl, | 2562.5 | 2.6 | Ad, | 2562.5 | 2.7 | K, | 2562.5 | 2.3 | Ro, |
| | | 2562.6 | 2.4 | Ya, | 2562.6 | 2.2 | Su, | 2562.6 | 2.5 | Po, | 2562.6 | 2.5 | Ps, |
| | | 2562.6 | 2.5 | L, | 2562.6 | 2.2 | Wo, | 2562.7 | 2.6 | Ba, | 2562.7 | 2.4 | Mz, |
| | | 2562.7 | 2.5 | Ad, | 2562.7 | 2.7 | Ca, | 2562.7 | 2.6 | E, | 2563.3 | 2.8 | Be, |
| | | 2563.3 | 2.3 | Pe, | 2563.3 | 2.9 | L, | 2563.5 | 2.8 | Wk, | 2563.3 | 2.8 | Gi, |
| | | 2563.5 | 2.8 | Ba, | 2563.5 | 2.8 | Ad, | 2563.5 | 2.6 | Cl, | 2563.5 | 2.5 | Ro, |
| | | 2563.5 | 2.6 | Pi, | 2563.6 | 2.7 | Ya, | 2563.6 | 2.5 | Wo, | 2563.7 | 2.8 | Ca, |
| | | 2563.7 | 2.9 | Ad, | 2563.8 | 3.1 | Po, | 2563.8 | 2.8 | M, | 2563.8 | 2.9 | E, |
| | | 2564.3 | 2.6 | Pe, | 2564.3 | 3.5 | Be, | 2564.3 | 3.5 | L, | 2564.3 | 3.0 | Ja, |
| | | 2564.4 | 3.1 | Gi, | 2564.4 | 3.1 | Ja, | 2564.5 | 2.1 | Hn, | 2564.5 | 3.0 | Ba, |
| | | 2564.6 | 3.2 | B, | 2564.6 | 3.3 | Pt, | 2564.6 | 3.2 | Wo, | 2564.6 | 3.3 | O, |
| | | 2564.6 | 3.3 | Ya, | 2564.6 | 2.9 | Cl, | 2564.7 | 3.3 | Po, | 2564.8 | 3.3 | M, |
| | | 2565.0 | 3.4 | Ym, | 2565.1 | 3.4 | Ym, | 2565.1 | 3.1 | Fk, | 2565.3 | 3.5 | L, |
| | | 2565.3 | 2.9 | Pe, | 2565.3 | 3.6 | Be, | 2565.3 | 3.7 | Gi, | 2565.4 | 3.5 | Ja, |
| | | 2565.5 | 3.2 | K, | 2565.5 | 2.7 | Cl, | 2565.5 | 3.1 | Ro, | 2565.6 | 3.6 | L, |
| | | 2565.6 | 3.6 | B, | 2565.6 | 3.4 | Pt, | 2565.7 | 3.8 | Ca, | 2565.8 | 3.5 | Mz, |
| | | 2565.8 | 3.4 | Ad, | 2565.9 | 4.1 | Ym, | 2566.0 | 3.6 | Fk, | 2566.0 | 3.8 | Ym, |
| | | 2566.3 | 3.8 | Gi, | 2566.3 | 3.3 | Pe, | 2566.3 | 3.5 | L, | 2566.3 | 3.7 | Ja, |
| | | 2566.5 | 3.7 | Ro, | 2566.5 | 2.8 | Hn, | 2566.5 | 3.4 | K, | 2566.5 | 3.6 | Ya, |
| | | 2566.6 | 3.7 | E, | 2566.6 | 3.8 | Pt, | 2566.6 | 3.7 | Wk, | 2566.6 | 3.7 | Po, |
| | | 2566.6 | 3.6 | Ba, | 2566.8 | 3.8 | Mz, | 2567.0 | 3.9 | Ym, | 2567.0 | 4.2 | Fk, |
| | | 2567.3 | 3.9 | Pe, | 2567.3 | 4.1 | L, | 2567.3 | 4.0 | Ja, | 2567.3 | 4.1 | Gi, |
| | | 2567.3 | 4.0 | Be, | 2567.4 | 3.9 | Ja, | 2567.5 | 3.7 | Ya, | 2567.5 | 3.0 | Hn, |
| | | 2567.5 | 4.0 | Ro, | 2567.5 | 4.0 | Ad, | 2567.6 | 4.3 | Ca, | 2567.6 | 4.2 | Po, |
| | | 2567.6 | 4.1 | E, | 2567.6 | 3.8 | Pt, | 2567.8 | 4.2 | M, | 2567.9 | 4.1 | Mz, |
| | | 2567.9 | 4.0 | Fk, | 2567.9 | 3.9 | Ym, | 2568.3 | 4.0 | Ja, | 2568.3 | 4.2 | Pe, |
| | | 2568.5 | 3.9 | Gd, | 2568.5 | 4.2 | Ro, | 2568.5 | 4.2 | K, | 2568.5 | 4.0 | Ya, |
| | | 2568.5 | 4.1 | Cl, | 2568.6 | 4.3 | Po, | 2568.6 | 4.0 | Pi, | 2568.6 | 4.1 | B, |
| | | 2568.6 | 3.5 | Hn, | 2568.6 | 4.0 | Ps, | 2568.6 | 4.1 | Pt, | 2568.6 | 4.0 | Wo, |
| | | 2568.7 | 4.4 | O, | 2568.8 | 4.2 | Mz, | 2569.0 | 4.3 | Fk, | 2569.5 | 4.3 | K, |
| | | 2569.5 | 4.0 | Hn, | 2569.5 | 4.2 | Ro, | 2569.6 | 4.2 | B, | 2569.6 | 4.0 | Pi, |
| | | 2569.6 | 4.2 | E, | 2569.6 | 4.2 | Pt, | 2569.6 | 4.3 | Su, | 2569.7 | 4.3 | Po, |
| | | 2569.7 | 4.2 | Ad, | 2569.8 | 4.3 | Mz, | 2569.8 | 4.3 | M, | 2570.5 | 4.0 | Hn, |
| | | 2570.5 | 4.4 | K, | 2570.5 | 4.4 | Ps, | 2570.5 | 4.4 | Co, | 2570.5 | 4.4 | Ad, |
| | | 2570.5 | 4.7 | Mo, | 2570.5 | 4.3 | Y, | 2570.5 | 4.4 | S, | 2570.5 | 4.4 | Hw, |
| | | 2570.5 | 4.4 | Bk, | 2570.5 | 4.4 | Rm, | 2570.5 | 4.4 | Hs, | 2570.5 | 4.5 | O, |
| | | 2570.5 | 4.4 | Fu, | 2570.5 | 4.4 | To, | 2570.6 | 3.9 | Wo, | 2570.6 | 4.4 | Po, |
| | | 2570.6 | 4.4 | Su, | 2570.6 | 4.5 | O, | 2570.6 | 4.3 | Gd, | 2570.6 | 4.3 | Pi, |

VARIABLE STAR OBSERVATIONS, August 20 to September 20, 1920—Continued.

| Number Name | J.D. Est. Obs. | J.D. Est. Obs. | J.D. Est. Obs. | J.D. Est. Obs. |
|---|---|---|---|---|
| 195653 Nova Cygni 3 | 2570.6 4.4 E, | 2570.6 4.2 B, | 2570.6 4.3 Ya, | 2570.6 4.4 Pt, |
| | 2570.8 4.4 Mz, | 2571.5 4.5 O, | 2571.6 4.5 Pt, | 2571.6 4.3 B, |
| | 2571.6 4.5 Pi, | 2571.6 4.2 Hn, | 2571.8 4.6 Mz, | 2572.5 4.5 Su, |
| | 2572.5 4.3 Cl, | 2572.5 4.6 Ad, | 2572.5 4.4 K, | 2572.7 4.6 Pt, |
| | 2572.7 4.5 Mz, | 2573.5 4.7 O, | 2573.5 4.5 Ro, | 2573.5 3.9 Cl, |
| | 2573.6 4.5 K, | 2573.6 4.5 B, | 2573.7 4.7 Po, | 2573.7 4.7 E, |
| | 2574.5 4.7 Ro, | 2574.6 5.0 V, | 2574.6 4.7 E, | 2574.6 4.7 Pt, |
| | 2574.8 4.6 M, | 2575.5 4.9 Ro, | 2575.5 4.7 Hn, | 2575.6 4.5 B, |
| | 2575.6 5.0 Ya, | 2575.6 4.7 Pt, | 2575.8 5.1 E, | 2575.9 4.8 Mz, |
| | 2576.5 4.7 K, | 2576.5 4.7 O, | 2576.5 4.6 Cl, | 2577.6 5.0 B, |
| | 2577.6 4.8 Pt, | 2578.6 5.3 Ad, | 2578.6 5.0 Pt, | 2578.6 5.2 B, |
| | 2578.6 5.5 V, | 2579.5 5.3 K, | 2579.5 5.4 Ad, | 2579.5 5.2 Ro, |
| | 2579.5 5.7 Cl, | 2579.6 4.8 O, | 2579.6 5.3 E, | 2579.6 5.0 Ps, |
| | 2579.7 5.4 Pt, | 2579.8 5.3 M, | 2580.5 5.3 Ro, | 2580.5 5.5 Ya, |
| | 2580.5 5.3 B, | 2580.5 5.3 Ad, | 2580.5 4.9 O, | 2580.6 5 6 Su, |
| | 2580.6 5.9 V, | 2580.7 5.5 Pt, | 2580.7 5.5 E, | 2581.5 5.4 B, |
| | 2581.5 5.8 Ad, | 2581.5 4.9 O, | 2581.6 5.4 E, | 2581.7 5.5 Pt, |
| | 2582.5 5.8 Ad, | 2582.6 5.8 Pt, | 2582.7 5.2 Mz, | 2583.5 5.7 Pt, |
| | 2583.6 5.7 E, | 2583.6 5.6 Cl, | 2583.7 5.7 Ad, | 2584.5 5.8 Cl, |
| | 2584.5 5.7 Ro, | 2584.5 5.2 O, | 2584.5 6.0 K, | 2584.5 5.2 Gd, |
| | 2584.6 6.1 E, | 2584.7 6.0 Ps, | 2584.7 5.5 M, | 2584.5 6.0 Ad, |
| | 2585.5 5.7 Gd, | 2585.5 5.8 O, | 2585.5 6.0 Pt, | 2585.5 5.6 Cl, |
| | 2585.6 6.0 Ad, | 2585.6 6.1 Ya, | 2585.7 6.2 E, | 2586.5 6.2 Pt, |
| | 2586.6 5.9 Ad, | 2587.6 5.6 M. | | |
| 195849 Z Cygni | 2538.5 12.6 Gi, | 2549.5 12.5 Gi, | 2559.5 12.7 Gi, | 2584.8 *12.1* M, |
| | 2585.5 12.7 Pi, | 2587.7 12.4 M. | | |
| 200212 SY Aquilae | 2546.6 *12.0* L, | 2585.6 *12.0* Pi, | 2587.6 13.5 M. | |
| 200357 S Cygni | 2584.8 *11.7* M, | 2587.7 14.0 M. | | |
| *200514* R Capricorni | 2543.4 10.5 Gi, | 2557.3 10.6 Gi. | | |
| 200647 SV Cygni | 2570.8 9.0 M, | 2571.6 8.3 Ya. | | |
| 200715a S Aquilae | 2531.6 10.9 K, | 2544.4 9.1 Gi, | 2549.4 9.2 Gi, | 2556.4 9.1 Gi, |
| | 2556.6 9.1 Cl, | 2568.6 9.3 B, | 2568.8 9.5 Mz, | 2569.6 9.4 Ya, |
| | 2574.6 9.8 Pt, | 2576.6 9.4 K, | 2576.6 9.5 Cl, | 2585.6 9.7 Pi, |
| | 2586.6 9.2 M. | | | |
| 200715b RW Aquilae | 2531.6 8.9 K, | 2556.6 9.2 Cl, | 2568.6 9.4 B, | 2568.8 9.2 Mz, |
| | 2569.6 9.2 Ya, | 2576.6 9.1 K, | 2576.6 9.2 Cl, | 2585.6 9.2 Pi, |
| | 2586.6 8.5 M. | | | |
| 200812 RU Aquilae | 2558.6 *13.4* B, | 2586.6 *12.0* M, | 2587.6 13.6 M. | |
| *200906* Z Aquilae | 2540.4 10.4 Gi, | 2550.4 11.5 Gi, | 2554.6 11.9 B. | |
| 200916 R Sagittae | 2556.6 9.1 Cl, | 2568.8 8.6 Mz, | 2569.6 9.1 Ya, | 2576.6 8.9 Cl, |
| | 2576.6 8.7 K, | 2586.6 9.1 M. | | |
| 200938 RS Cygni | 2513.2 8.2 Ch, | 2545.6 7.2 L, | 2554.3 7.3 L, | 2557.3 7.3 L, |
| | 2564.6 7.6 Ya, | 2569.8 9.0 M, | 2575.6 8.2 Gd, | 2580.8 7.2 Pt. |
| 201008 R Delphini | 2546.6 12.8 L. | | | |
| *201121* RT Capricor. | 2547.4 6.9 L, | 2555.4 7.2 L, | 2564.3 6.5 L, | 2570.6 7.8 Ya, |
| | 2580.7 8.4 Bs. | | | |
| 201130 SX Cygni | 2584.8 *12.0* M, | 2587.7 *14.0* M. | | |
| *201139* RT Sagittarii | 2485.6 7.4 Tp, | 2487.6 7.4 Tp, | 2521.6 7.4 Dw, | 2522.6 7.3 Tp, |
| | 2582.6 10.2 Pt. | | | |
| 201437a P Cygni | 2513.2 5.0 Ch, | 2550.4 5.1 Pe. | | |
| 201647 U Cygni | 2541.4 8.9 Gi, | 2544.7 10.2 Mz, | 2556.4 8.6 Gi, | 2557.8 9.9 Pt, |
| | 2567.5 8.5 Ya, | 2569.8 9.2 M, | 2576.6 9.3 Gd, | 2580.6 9.8 Gd, |
| | 2581.6 9.2 $Wl_2$, | 2584.7 10 0 Ps, | 2585.5 10.3 Pi. | |
| *202240* U Microscop. | 2485.6 8.5 Tp, | 2487.6 8.4 Tp, | 2521.6 9.2 Dw. | 2522.6 9.1 Tp. |
| 202539 RW Cygni | 2570.8 8.9 M, | 2571.6 9.0 Ya, | 2581.6 9.1 Wl. | |
| *202622* RU Capricor. | 2543.4 9.8 Gi, | 2556.6 10.1 B, | 2557.4 10.0 Gi. | |
| 202817 Z Delphini | 2557.6 9.4 B, | 2574.6 9.3 Pt, | 2586.5 9.5 Pi. | |
| 202946 SZ Cygni | 2531.6 9.0 K, | 2569.5 9.8 K, | 2570.5 10.2 Cl, | 2570.8 10.0 M, |

VARIABLE STAR OBSERVATIONS, August 20 to September 20, 1920—Continued.

| Number | Name | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 202946 | SZ Cygni | 2571.6 | 9.7 | Ya, | 2571.6 | 9.9 | Cl, | 2572.6 | 10.0 | Cl, | 2572.6 | 9.6 | K, |
| | | 2576.6 | 9.3 | K, | 2576.6 | 9.4 | Cl, | 2579.5 | 9.3 | K, | 2579.6 | 9.9 | Cl, |
| 202954 | ST Cygni | 2558.6 | 12.9 | B, | 2585.5 | 9.2 | Pi, | 2587.6 | 12.4 | M. | | | |
| 203226 | V Vulpec. | 2570.8 | 8.7 | M, | 2582.7 | 8.8 | Pt. | | | | | | |
| 203816 | S Delphini | 2531.6 | 8.8 | K, | 2547.7 | 8.8 | Mz, | 2556.5 | 8.8 | Cl, | 2572.5 | 9.3 | Cl, |
| | | 2580.6 | 8.5 | V, | 2581.6 | 9.3 | Hl, | 2586.5 | *12.4* | Pi, | 2587.6 | 8.8 | M. |
| 203847 | V Cygni | 2504.2 | 10.5 | Ch, | 2510.2 | 10.4 | Ch, | 2545.4 | 9.3 | Gi, | 2555.6 | 9.5 | B, |
| | | 2558.3 | 9.1 | Gi, | 2569.8 | 10.3 | M. | | | | | | |
| *203905* | Y Aquarii | 2546.4 | 10.7 | Pe. | | | | | | | | | |
| 204016 | T Delphini | 2553.3 | *11.6* | Pe, | 2585.6 | 13.5 | Hl, | 2587.6 | 15.3 | M. | | | |
| *204104* | W Aquarii | 2545.4 | 13.1 | Gi, | 2546.4 | 13.1 | Pe, | 2558.4 | 13.3 | Gi. | | | |
| *204215* | U Capric. | 2543.4 | 13.8 | Gi, | 2557.4 | *13.4* | Gi. | | | | | | |
| 204318 | V Delphini | 2541.4 | *12.5* | Gi, | 2554.4 | *12.5* | Gi, | 2555.6 | *12.7* | B. | | | |
| *204405* | T Aquarii | 2504.2 | *11.0* | Ch, | 2513.2 | 10.8 | Ch, | 2546.3 | 7.9 | Pe, | 2557.3 | 7.1 | Pe, |
| | | 2561.7 | 7.6 | Mz, | 2569.5 | 7.5 | K, | 2571.6 | 7.6 | Ya, | 2574.6 | 7.3 | Pt, |
| | | 2578.6 | 7.4 | B, | 2581.6 | 7.9 | Gd. | | | | | | |
| 204846 | RZ Cygni | 2543.4 | 11.6 | Gi, | 2558.4 | 12.0 | Gi, | 2587.6 | 12.2 | M. | | | |
| 205017 | X Delphini | 2572.6 | *12.0* | Cl. | | | | | | | | | |
| 205030a | UX Cygni | 2584.8 | 11.7 | M. | | | | | | | | | |
| *205627* | RR Capricor. | 2485.6 | 11.1 | Tp, | 2521.6 | 13.7 | Dw. | | | | | | |
| 205923 | R Vulpeculae | 2544.4 | 12.0 | Gi, | 2556.6 | 13.2 | B, | 2558.4 | *13.0* | Gi, | 2570.7 | *11.5* | Bs, |
| | | 2582.7 | 11.3 | Pt, | 2584.8 | 10.8 | M. | | | | | | |
| *210116* | RS Capricorn. | 2570.6 | 8.1 | Ya. | | | | | | | | | |
| *210124* | V Capricorn. | 2543.5 | 12.5 | Gi, | 2557.4 | 12.7 | Gi. | | | | | | |
| *210221* | X Capricorn. | 2543.5 | *12.1* | Gi, | 2557.4 | 13.0 | Gi. | | | | | | |
| *210504* | RS Aquarii | 2542.4 | 12.1 | L. | | | | | | | | | |
| 210868 | T Cephei | 2510.2 | 9.0 | Ch, | 2539.4 | 9.7 | L, | 2546.6 | 10.1 | L, | 2555.4 | 10.0 | L, |
| | | 2557.8 | 10.0 | Pt, | 2564.7 | 9.8 | Ya, | 2570.8 | 10.3 | M, | 2576.5 | 10.1 | O, |
| | | 2587.6 | 10.5 | Pi. | | | | | | | | | |
| 211614 | X Pegasi | 2585.6 | 10.3 | Pt. | | | | | | | | | |
| *211615* | T Capricorn. | 2570.6 | 10.0 | Ya, | 2581.5 | 10.6 | Gd. | | | | | | |
| *212030* | S Micros. | 2521.6 | 9.2 | Dw. | | | | | | | | | |
| 213244 | W Cygni | 2539.3 | 5.5 | L, | 2545.6 | 5.5 | L, | 2549.3 | 5.7 | L, | 2554.1 | 6.2 | Ym, |
| | | 2555.3 | 5.6 | L, | 2555.3 | 5.8 | Be, | 2556.0 | 6.3 | Ym, | 2557.3 | 5.5 | Be, |
| | | 2558.3 | 5.9 | Be, | 2558.3 | 5.8 | L, | 2558.3 | 6.3 | Pe, | 2561.2 | 6.3 | Ym, |
| | | 2562.1 | 6.3 | Ym, | 2562.3 | 5.7 | L, | 2562.3 | 5.7 | Be, | 2564.3 | 5.8 | L. |
| 213678 | S Cephei | 2541.5 | 9.3 | Gi, | 2554.4 | 9.6 | Gi, | 2560.6 | 11.2 | Po, | 2570.8 | 11.3 | M. |
| 213753 | RU Cygni | 2571.6 | 9.4 | Ya, | 2574.8 | 9.3 | M. | | | | | | |
| 213843 | SS Cygni | 2501.2 | 8.3 | Ch, | 2504.2 | 8.5 | Ch, | 2505.2 | 8.6 | Ch, | 2510.2 | 10.8 | Ch, |
| | | 2516.2 | 11.4 | Ch, | 2526.6 | 10.9 | K, | 2531.2 | 12.1 | Ch, | 2531.6 | 11.5 | K, |
| | | 2532.6 | *11.3* | K, | 2533.6 | *10.9* | K, | 2538.4 | 11.9 | Gi, | 2539.3 | 11.6 | L, |
| | | 2539.4 | 11.8 | Gi, | 2540.0 | 12.1 | Ym, | 2540.5 | 11.9 | Gi, | 2541.3 | 12.0 | Pe, |
| | | 2541.4 | 12.0 | Gi, | 2541.4 | 11.7 | L, | 2542.1 | 12.1 | Ym, | 2542.4 | 12.0 | Gi, |
| | | 2542.4 | 11.8 | L, | 2543.0 | 12.0 | Ym, | 2543.3 | 12.0 | Pe, | 2543.5 | 12.0 | Gi, |
| | | 2544.0 | 12.0 | Ym, | 2544.3 | 12.0 | Pe, | 2544.4 | 12.0 | Gi, | 2545.3 | 12.0 | Pe, |
| | | 2545.4 | 12.0 | Gi, | 2545.6 | 12.0 | L, | 2546.4 | 12.0 | Gi, | 2546.6 | 12.1 | L, |
| | | 2547.1 | 12.0 | Ym, | 2547.4 | 12.0 | Gi, | 2547.4 | 11.7 | L, | 2548.3 | 12.0 | Gi, |
| | | 2549.1 | 12.3 | Ym, | 2549.3 | 12.0 | Pe, | 2549.4 | 11.9 | Gi, | 2549.4 | 11.7 | L, |
| | | 2550.0 | 12.1 | Ym, | 2550.4 | 11.9 | Gi, | 2551.3 | 11.9 | Gi, | 2553.3 | 12.0 | Pe, |
| | | 2553.3 | 11.7 | L, | 2554.1 | 12.1 | Ym, | 2554.3 | 11.7 | L, | 2554.4 | 11.9 | Gi, |
| | | 2554.6 | 11.9 | B, | 2555.3 | 12.0 | Gi, | 2555.3 | 11.9 | L, | 2555.6 | 12.0 | B, |
| | | 2556.0 | 12.3 | Ym, | 2556.3 | 12.0 | Gi, | 2556.3 | 11.7 | L, | 2556.5 | 12.0 | Cl, |
| | | 2556.6 | 12.0 | L, | 2556.6 | 12.0 | B, | 2557.3 | 11.7 | L, | 2557.4 | 12.0 | Gi. |
| | | 2557.6 | 12.1 | B, | 2557.8 | 11.7 | Pt, | 2558.3 | 11.9 | Pe, | 2558.3 | 12.0 | Gi, |
| | | 2558.3 | 11.7 | L, | 2558.5 | *11.9* | Cl, | 2558.6 | 11.9 | B, | 2559.2 | 12.3 | Ym. |
| | | 2559.4 | 12.0 | Gi, | 2559.6 | 12.1 | L, | 2559.8 | 11.9 | Pt, | 2560.5 | 12.0 | Gi, |
| | | 2560.6 | 12.1 | Gd, | 2560.6 | *11.3* | Po, | 2560.6 | 11.5 | Cl, | 2560.8 | 12.1 | M, |
| | | 2561.1 | 12.3 | Ym, | 2561.6 | 12.0 | B, | 2562.1 | 12.0 | Ym, | 2562.3 | 11.8 | L, |
| | | 2562.3 | 12.0 | Gi, | 2562.6 | 12.0 | B, | 2562.6 | 12.2 | L, | 2563.3 | 12.0 | Gi, |
| | | 2564.3 | 11.7 | L, | 2564.4 | 12.0 | Gi, | 2564.6 | 12.0 | B, | 2564.7 | 10.9 | Ya. |

VARIABLE STAR OBSERVATIONS, August 20 to September 20, 1920—Continued.

| Number | Name | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. | J.D. | Est. | Obs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 213843 | SS Cygni | 2565.3 | 11.8 | L, | 2565.5 | 8.2 | Gd, | 2565.6 | 12.0 | B, | 2565.6 | 12.0 | Gi, |
| | | 2566.0 | *10.0* | Ym, | 2566.3 | 11.7 | Gi, | 2567.3 | 8.5 | L, | 2567.3 | 9.2 | Gi, |
| | | 2567.6 | 8.3 | Pt, | 2567.8 | 8.7 | M, | 2568.0 | 8.0 | Ym, | 2568.3 | 8.3 | Pe, |
| | | 2568.5 | 8.2 | Gd, | 2568.5 | 8.6 | K, | 2568.5 | 8.3 | Cl, | 2568.6 | 8.2 | Pt, |
| | | 2568.6 | 8.5 | B, | 2569.5 | 8.5 | K, | 2569.5 | 8.4 | Ya, | 2569.6 | 8.4 | Pt, |
| | | 2569.6 | 8.5 | B, | 2569.6 | 8.6 | Cl, | 2569.8 | 8.4 | M, | 2570.5 | 8.6 | K, |
| | | 2570.5 | 8.6 | Cl, | 2570.6 | 8.7 | Pt, | 2570.6 | 8.3 | Ya, | 2570.6 | 8.5 | Po, |
| | | 2570.6 | 8.7 | B, | 2570.8 | 8.3 | M, | 2571.6 | 8.4 | Ya. | 2571.6 | 8.7 | B, |
| | | 2572.5 | 8.4 | Cl, | 2572.5 | 8.5 | K, | 2573.5 | 8.5 | Ro, | 2573.5 | 8.3 | O, |
| | | 2573.5 | 8.3 | Cl, | 2573.6 | 8.5 | K, | 2574.5 | 8.6 | Ro, | 2574.6 | 8.6 | Pt, |
| | | 2574.8 | 8.6 | M, | 2575.5 | 8.6 | Ro, | 2575.6 | 8.8 | B, | 2575.6 | 8.7 | Ya, |
| | | 2575.6 | 8.6 | Pt, | 2576.5 | 8.7 | Cl, | 2576.5 | 8.4 | O, | 2576.5 | 8.7 | K, |
| | | 2576.6 | 8.2 | Gd, | 2577.6 | 8.9 | B, | 2578.6 | 9.2 | Pt, | 2578.6 | 9.4 | B, |
| | | 2578.8 | 9.5 | M, | 2579.5 | 9.6 | Ro, | 2579.6 | 10.2 | Jd, | 2579.5 | 9.6 | Gd, |
| | | 2579.5 | 9.7 | Cl, | 2579.5 | 9.4 | K, | 2579.6 | 9.4 | O, | 2579.8 | 9.6 | M, |
| | | 2579.8 | 10.0 | Pt, | 2580.5 | 10.2 | Ya, | 2580.5 | 9.8 | Ro, | 2580.6 | 10.2 | Gd, |
| | | 2580.6 | 10.2 | V, | 2580.6 | 10.0 | Wl, | 2580.7 | 10.2 | Pt, | 2580.8 | 10.2 | M, |
| | | 2581.5 | 10.3 | B, | 2581.6 | 10.9 | Gd, | 2582.6 | 10.9 | Pt, | 2582.6 | 11.0 | Gd, |
| | | 2583.6 | 11.8 | Cl, | 2584.5 | *11.0* | Cl, | 2584.5 | 11.3 | K, | 2584.5 | 12.2 | Ro, |
| | | 2584.5 | 11.9 | Gd, | 2584.6 | 11.9 | Pi, | 2584.8 | 12.0 | M, | 2585.5 | *11.8* | Cl, |
| | | 2585.5 | 11.9 | Pi, | 2585.6 | 11.5 | Pt, | 2585.6 | *11.8* | Ya, | 2586.6 | 11.9 | Pt, |
| | | 2587.6 | 11.9 | Pi. | | | | | | | | | |
| 213937 | RV Cygni | 2571.6 | 7.8 | Ya. | | | | | | | | | |
| 214024 | RR Pegasi | 2574.6 | 9.1 | Pt, | 2581.6 | 9.2 | B. | | | | | | |
| *214247* | R Gruis | 2521.6 | 13.5 | Dw. | | | | | | | | | |
| 215934 | RT Pegasi | 2570.8 | 11.0 | M, | 2582.6 | 11.0 | Pt. | | | | | | |
| 220412 | T Pegasi | 2545.5 | 11.8 | Gi, | 2547.4 | 12.0 | L, | 2557.4 | 12.2 | Gi, | 2570.8 | *11.6* | M, |
| | | 2581.6 | 13.7 | B. | | | | | | | | | |
| 220613 | Y Pegasi | 2545.5 | 10.5 | Gi, | 2557.5 | 9.9 | Gi, | 2581.6 | 10.7 | B, | 2584.5 | *10.9* | Cl, |
| | | 2587.6 | 11.3 | Pi. | | | | | | | | | |
| 220714 | RS Pegasi | 2545.5 | 11.1 | Gi, | 2557.5 | 11.3 | Gi, | 2584.5 | 11.0 | Cl, | 2587.6 | 12.2 | Pi. |
| *221948* | S Gruis | 2521.6 | 8.1 | Dw. | | | | | | | | | |
| 222129 | RV Pegasi | 2578.7 | 10.3 | B. | | | | | | | | | |
| 222439 | S Lacertae | 2538.4 | 11.7 | Gi, | 2547.4 | 12.5 | L, | 2548.4 | 12.1 | Gi, | 2558.4 | 12.8 | Gi, |
| | | 2578.7 | 13.0 | B. | | | | | | | | | |
| *223462* | T Tucanae | 2521.6 | 13.7 | Dw. | | | | | | | | | |
| 223841 | R Lacertae | 2538.5 | *13.6* | Gi, | 2544.4 | *12.6* | L, | 2548.5 | *13.7* | Gi, | 2558.5 | 13.9 | Gi, |
| 225914 | RW Pegasi | 2569.5 | 10.6 | K, | 2575.6 | 9.7 | Gd, | 2578.7 | 10.6 | B, | 2580.6 | 10.4 | V, |
| | | 2580.8 | 10.4 | M, | 2584.5 | 11.2 | K, | 2587.6 | 10.8 | Pi. | | | |
| 230110 | R Pegasi | 2561.8 | *11.5* | Bs, | 2561.8 | 11.3 | Mz, | 2571.6 | *10.4* | Jd, | 2580.8 | 12.8 | M, |
| | | 2581.8 | *11.5* | Bs, | 2584.6 | *12.4* | Pi. | | | | | | |
| 230759 | V Cassiop. | 2541.5 | 11.1 | Gi, | 2543.4 | 11.4 | Pe, | 2548.3 | 11.4 | Pe, | 2554.5 | 10.6 | Gi, |
| | | 2560.8 | *11.5* | Bs, | 2561.8 | *11.7* | Mz, | 2570.5 | 9.6 | Hn, | 2574.6 | 10.4 | Pt, |
| | | 2576.5 | 10.5 | O, | 2584.6 | 9.9 | Pi. | | | | | | |
| 231425 | W Pegasi | 2547.4 | 12.5 | L, | 2554.4 | 12.4 | L, | 2580.8 | 11.8 | M. | | | |
| 231508 | S Pegasi | 2543.4 | 10.1 | Pe, | 2545.4 | 10.6 | Pe, | 2553.3 | 10.8 | Pe, | 2571.6 | 11.2 | Jd, |
| | | 2580.8 | 8.2 | M, | 2581.6 | 8.2 | B, | 2582.6 | 8.4 | Pt. | | | |
| *232746* | V Phoenic. | 2521.6 | 11.5 | Dw. | | | | | | | | | |
| 233335 | ST Androm. | 2514.2 | 10.0 | Ch, | 2544.1 | 11.0 | Ym, | 2557.8 | 11.1 | Pt, | | | |
| | | 2568.1 | *11.7* | Ym, | 2569.5 | 11.4 | K, | 2573.6 | 10.9 | O, | 2581.6 | 11.5 | B, |
| | | 2582.6 | 10.8 | Gd, | 2584.6 | 11.6 | Pi, | 2584.8 | 10.3 | M. | | | |
| *233815* | R Aquarii | 2544.8 | 9.8 | Mz, | 2557.8 | 10.6 | Pt. | | | | | | |
| 235053 | RR Cassiop. | 2575.6 | 12.5 | B. | | | | | | | | | |
| *235150* | R Phoenic. | 2521.6 | 9.8 | Dw. | | | | | | | | | |
| 235350 | R Cassiop. | 2539.5 | 7.5 | Gi, | 2549.4 | 7.6 | Gi, | 2559.4 | 7.8 | Gi, | 2561.7 | 9.0 | Bs, |
| | | 2563.8 | 8.2 | Bs, | 2577.7 | 7.9 | Bs, | 2577.6 | 7.7 | B, | 2584.6 | 8.6 | Pi. |
| 235525 | Z Pegasi | 2557.8 | 10.0 | Pt, | 2576.5 | 9.8 | O. | | | | | | |
| 235855 | Y Cassiop. | 2541.5 | *13.0* | Bi, | 2554.5 | *13.0* | Gi. | | | | | | |
| 235939 | SV Androm. | 2581.6 | 12.4 | B, | 2584.6 | 12.3 | Pi. | | | | | | |

No. of Observations: 1749. No. of Stars Observed: 262. No. of Observers: 47.

ANNUAL REPORT OF THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS, 1919-20.

| Observer. | Initial | November | December | January | February | March. | April | May | June | July | August | September | October | Totals. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bancroft | Ba | ... | ... | ... | ... | ... | 205 | 195 | ... | 71 | ... | ... | .... | 471 |
| Barns | Bs | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 14 | 64 | 78 |
| Benini | Be | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 21 | 21 |
| Bouton | B | 85 | 73 | 19 | ... | ... | 31* | 34 | 2 | ... | ... | 22 | 95 | 361 |
| Brown | Bn | 4 | 4 | ... | ... | ... | ... | ... | ... | 3 | 8 | ... | 3 | 22 |
| Bunch | Bh | 18 | 19 | ... | ... | ... | ... | ... | ... | 4 | 12 | ... | .... | 57 |
| Carr | Ca | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 29 | 29 |
| Chandra | Ch | ... | ... | ... | 9 | 38 | 41 | 40 | 35 | 37 | 45 | 35 | 48 | 328 |
| Clement | Cl | 28 | 34 | 17 | 17 | 8 | ... | 15 | 6 | 5 | 17 | 49 | 86 | 287 |
| Dawson (δ) | Dw | 84 | 8 | ... | ... | ... | 127 | ... | ... | ... | ... | ... | 70 | 289 |
| Downer, Miss | Do | 12 | 14 | ... | 10 | 7 | ... | ... | ... | ... | ... | ... | .... | 43 |
| Eaton | E | 21 | 48 | 47 | 27 | 49 | 9 | 10 | 4 | 3 | ... | 6 | 15 | 239 |
| Furukawa | Fk | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 9 | 9 |
| Gartlein | Ga | ... | ... | ... | ... | ... | 2 | 3 | 5 | ... | ... | ... | 6 | 16 |
| Ginori | Gi | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 81 | 129 | 210 |
| Godfrey | Gd | 2 | 21 | 2 | ... | ... | ... | 5 | 3 | ... | 1 | ... | 36 | 70 |
| Hay | Hy | ... | 6 | ... | 8 | ... | ... | ... | ... | ... | ... | ... | .... | 14 |
| Henckel | Hn | 4 | 4 | ... | ... | ... | ... | ... | ... | 2 | ... | ... | 21 | 31 |
| Hunter | Hu | 21 | 35 | 18 | 11 | ... | ... | ... | ... | ... | ... | ... | .... | 85 |
| Janczewski | Ja | ... | ... | ... | ... | ... | 20 | 68 | 56 | ... | 55 | 81 | .... | 280 |
| Jenkins, Miss | Jk | 5 | 12 | 17 | 14 | 9 | 10 | 28 | 4 | 9 | ... | ... | .... | 108 |
| Jordan | Jd | 1 | 4 | 5 | 11 | ... | ... | ... | ... | 3 | 2 | ... | 7 | 33 |
| Kaster | Ka | ... | ... | ... | ... | ... | ... | ... | ... | ... | 17 | ... | .... | 17 |
| Kimball | K | 20 | 32 | ... | ... | ... | ... | 3 | ... | 6 | 19 | ... | 82 | 162 |
| Lacchini | L | 139 | 67 | ... | 42 | 145 | 107 | 132 | 117 | 110 | ... | 68 | 144 | 1071 |
| McAteer | M | 58 | 140 | 24 | 29 | 51 | 20 | 121 | 95 | 152 | 160 | 84 | 124 | 1058 |
| Menzel | Mz | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 6 | 43 | 49 |
| Merrill | Ml | ... | ... | ... | ... | ... | ... | 16 | ... | 21 | 8 | 13 | .... | 58 |
| Mundt | Mu | 31 | 13 | 6 | 7 | 4 | 5 | 15 | 9 | 30 | 35 | 30 | 27 | 212 |
| Olcott | O | ... | ... | ... | ... | ... | ... | ... | ... | 22 | 63 | ... | 37 | 122 |
| Peltier | Pt | 44 | 49 | 24 | 42 | 72 | 82 | 101 | 97 | 124 | 112 | 92 | 154 | 993 |
| de Perrot | Pe | 71 | 52 | 28 | ... | 9 | 38 | 42 | 16 | 25 | 68 | 10 | 90 | 449 |
| Peters | Ps | ... | ... | ... | ... | ... | ... | ... | ... | ... | 28 | 29 | 15 | 72 |
| Pickering | Pi | 59 | 70 | 36 | ... | 28 | 24 | 34 | 57 | 39 | 22 | ... | 47 | 416 |
| Potter | Po | ... | ... | ... | ... | ... | ... | ... | ... | 11 | 25 | 10 | 16 | 62 |
| Rhorer | Ro | ... | ... | ... | ... | ... | ... | 23 | 38 | 17 | ... | 3 | 28 | 109 |
| Suter | Su | 7 | 3 | ... | ... | 4 | 3 | 10 | ... | 4 | 9 | 11 | 14 | 65 |
| Tapia | Tp | 72 | 65 | ... | ... | ... | ... | ... | ... | ... | ... | ... | 69 | 206 |
| Thompson | Th | ... | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 3 | .... | 6 |
| Vrooman | V | 11 | 13 | ... | 27 | 10 | 10 | ... | 22 | 17 | ... | ... | 30 | 140 |
| Waldo | Wl | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 9 | 9 |
| Whitehorn | Wh | 1 | 59 | ... | ... | ... | ... | ... | ... | ... | ... | ... | .... | 60 |
| Woglom | Wg | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 7 | 3 | .... | 12 |
| Yalden | Ya | 10 | 13 | 6 | 14 | 14 | 14 | 7 | 14 | 12 | 19 | 1 | 52 | 176 |
| Yamamoto | Ym | ... | ... | ... | ... | ... | ... | ... | ... | 12 | ... | ... | 68 | 80 |
| Yont | Yo | 1 | ... | ... | 8 | 1 | 9 | ... | ... | ... | ... | ... | .... | 19 |
| Young, Miss | Y | 22 | 52 | 52 | 42 | 50 | 34 | 41 | 26 | 15 | ... | ... | .... | 334 |
| 22 Others | ..... | 17 | 4 | ... | ... | ... | 3 | 9 | 2 | ... | 2 | 3 | 30 | 70 |
| Totals | ..... | 848 | 914 | 301 | 318 | 499 | 794 | 952 | 608 | 756 | 737 | 654 | 1718 | 9099 |
| Stars Observed | ..... | 240 | 257 | 163 | 114 | 180 | 193 | 240 | 245 | | 217 | | 262 | 395 |
| Observers | ..... | 30 | 27 | 15 | 15 | 16 | 21 | 24 | 19 | 26 | 24 | 22 | 47 | 69 |

ANNUAL RECORD OF THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

| YEAR. | OBSERVATIONS. | STARS OBSERVED. | OBSERVERS. |
|---|---|---|---|
| 1912 | 6180 | 175 | 19 |
| 1913 | 12914 | 200 | 20 |
| 1914 | 14506 | 255 | 28 |
| 1915 | 14724 | 282 | 29 |
| 1916 | 11261 | 290 | 30 |
| 1917 | 15788 | 332 | 43 |
| 1918 | 16112 | 380 | 34 |
| 1919 | 8710 | 352 | 53 |
| 1920 | 9099 | 395 | 69 |
| | 109294 | | |

## COMET AND ASTEROID NOTES.

**Encke's Comet** is due to reach perihelion the middle of July, 1921. July 12 seems to be the time. Below is given a search Ephemeris of the Comet for November, 1920. The Comet will, during November, 1920, be at a great distance from the Earth, (average 2.57 units), but the large photographic telescopes should be able to find it.

SEARCH EPHEMERIS OF ENCKE'S COMET FOR NOVEMBER, 1920.

| 1920 | α h | α m | α s | δ ° | δ ′ | δ ″ | Log. $r$ | Log. $\Delta$ |
|---|---|---|---|---|---|---|---|---|
| Nov. 1.5 | 22 | 46 | 38 | —0 | 46 | 25 | 0.49256 | 0.38946 |
| 5.5 | 22 | 44 | 32 | —1 | 2 | 41 | 0.48910 | 0.39496 |
| 9.5 | 22 | 42 | 50 | —1 | 16 | 48 | 0.48554 | 0.40071 |
| 13.5 | 22 | 41 | 33 | —1 | 28 | 35 | 0.48190 | 0.40666 |
| 17.5 | 22 | 40 | 40 | —1 | 38 | 5 | 0.47816 | 0.41276 |
| 21.5 | 22 | 40 | 10 | —1 | 45 | 16 | 0.47434 | 0.41889 |
| 25.5 | 22 | 40 | 4 | —1 | 50 | 5 | 0.47040 | 0.42499 |
| 29.5 | 22 | 40 | 19 | —1 | 52 | 38 | 0.46638 | 0.43107 |

F. E. SEAGRAVE.

## COMMUNICATIONS.

**Occultations of Jupiter's Satellites, One by Another.**—Several times this spring during the months of March, April and May, I have observed one of Jupiter's four moons pass behind or in front of another, causing the two to appear in the telescope as one moon, or making an eclipse. Supposing it to be a common occurrence I made no special note of the observation. But on looking through half a dozen works on Astronomy as well as the American Ephemeris I could find no mention of any thing of that kind taking place, so I determined to look more closely and make inquiries. On the evening of May 29,

time, $9^h$ $15^m$ P. M., observed Satellite III emerge from shadow, seeing good. May 29, time $11^h$ P. M., observed Satellite I pass behind Satellite IV, these two moons now appeared as one for about forty minutes before I could separate them, using powers of 56 and 76 with 4-inch objective. What I am anxious to know is, do the earth and Jupiter have to be specially situated in their orbits for this phenomenon to take place? And why is no mention made of it by astronomers?

Washta, Iowa, June 11, 1920. FRED S. CARRINGTON.

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**Jupiter's Satellite Occultations.**—I have again had the good luck, pleasure and satisfaction of observing an occultation or eclipse of one of Jupiter's moons by another. There was no mistake or illusion this time. I had been looking for Mercury for a week, got a look at that planet on the evening of June 30; but the horizon was cloudy. On Thursday evening, July 1, the seeing was ideal. I picked up the little silvery planet and watched it for $35^m$, until it sunk below the ground where earth and sky met. On turning the 4-inch telescope on Jupiter I saw that the two satellites on the upper side of the ecliptic (in the telescope) were not very far from each other; it soon became apparent that they were drawing together (this was at $8^h$ $35^m$ P. M.). As Jupiter set at $9^h$ $20^m$, it became a most exciting race as to whether the two satellites would come together before the planet touched the horizon. This was far more interesting to me than all the racing on earth that I had ever seen. If hope and desire could have influenced the planet, it would certainly have been arrested in its downward motion until Ganymede and Callisto met and passed each other. The four moons, two on each side of the planet's disc, were in the line of the ecliptic; above were Regulus, Saturn, Spica and Mars. At $9^h$ $50^m$ the little racers had won; but little more than by the contact (my 4-inch does not disc the satellites) but they had touched each other. So perfect was the seeing that just 15 minutes after, I plainly saw the two little moons, locked together, sink below the ground a second or two before Jupiter's disc touched it and was gone for the night. I had to look in the Ephemeris for the positions of the satellites, to know the names of the two that had occulted. The phenomenon is not mentioned there. While observing, I was sure that the satellite towards the planet's disc was III on account of its brightness. Mr. J. W. Salsbury, Port Tampa, Fla., sends me the following quotation from "Webb" as the only mention he has seen in "the books" of an occurrence of this kind: "As the plane of their orbits pass so nearly through the sun and our eyes, it seems remarkable that though respective occultations have been seen, there is only one recorded instance of the eclipse of one satellite by the shadow of another". In the March number of POPULAR ASTRONOMY, Mr. G. H. Hamilton, of Lowell Observatory, describing the eclipse of the satellites, says, "the period during which one may observe them can only occur twice in Jupiter's revolution in its orbit, or every six years. His observation was early in last December, 1919. For how long a period do Jupiter, earth, and sun, remain in position for these satellite eclipses of each other to occur?

FRED S. CARRINGTON.

Washta, Iowa.

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**The Reform of the Calendar.**—With great interest I have read the article concerning the "Calendar" in POPULAR ASTRONOMY, May 1919, pages 334-38, still a proof that many authors in nearly all countries since 1884 have proposed

the impractical Gregorian calendar simplified. As a matter of course, the proposals are nearly all alike, different only in the particulars.

My proposal, which was published in Danish in a small pamphlet in 1918 in *Scandinavian Astronomical Review*, Copenhagen, in the October issue, 1918, page 6-11, is the following:

1. March, June, September, and December each 31 days, the other 8 months each 30 days, the 4 quarters of the year are equal: $4 \times 91 = 364$ days.

2. The 365th day is kept separated from the date and the days of the week and placed as a sort of New Year's Day between December 31 and January 1.

3. The intercalary day, which necessarily will appear each 4th year, is likewise kept without daily and weekly indication and placed between December 32 and January 1. December will consequently in each 4th year contain 33 days.

4. Easter Sunday shall always be appointed on April 7, as I take it for granted that the normal calendar is so begun that January 1 is a Sunday, that is celebrated as a holy day all over the world. Whitsunday will thus occur on May 27.

5. The hours should be counted from 1 to 24 daily, starting at the present 6 o'clock A. M., which thus will be 24 o'clock = 0 o'clock, and thus that the small numbers from 1 o'clock to 12 o'clock are the hours for business, and the hours from 12 o'clock to 24 o'clock the time after the closing of the offices, factories, etc., an idea which I forwarded in 1912 to the French Ministry of the Interior and the French Ministry for Public Works, which, in a communication of May 22, 1912, acknowledged the receipt of my proposal.

According to my proposal the Sundays will always be coincident with the following dates:

1- 8-15-22-29—Jan. April, July, Oct.
6-13-20-27 —Feb. May, Aug., Nov.
4-11-18-25 —March, June, Sept., Dec.

The 1st in each month will thus always be:

A Monday in Jan., April, July, Oct.
A Wednesday in Feb., May, Aug., Nov.
A Friday in March, June, Sept., Dec.

The advantage of adding both the intercalary day to the termination of the year, December 32 and 33 respectively, is that the business year will become continuous 52 weeks of 7 days = 364 days, and that the calculation of interest, etc., is easily done—for instance:

11 June No. 162 viz. $91 + 60 + 11$.
1 July No. 183 viz. $91 \times 2 + 1$.
11 Dec. No. 344 viz. $91 \times 3 + 71$.

For astronomy it will be very important that the first 364 days are fixed and unchangeable without the interruption each fourth year by an extra intercalary day, June 32, as many other authors have proposed.

THORVALD KORNERUP.

Copenhagen, Denmark.

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**Bolshevist Science.**— Leverrier found that the progression of Mercury's apse was greater than could be accounted for by the attraction of the outside planets. Strange to say he considered the sun to be a sphere, attracting like a point, and therefore concluded that there must be some unrecognized inside mass, such as an interior planet or planets, or a swarm of meteors in the vicinity of the sun. This led to a search for inside planets, which, as is well known, resulted in the "discovery" of "Vulcan."

The fact is, however, that the sun, being a rotating body, does not attract like a point but like a disc, and this is equivalent to an inside mass over and above any meteoric swarms that may exist. A spheroid, owing to its disc action, causes the apse of a body revolving about it in an oval orbit to progress. This action is a differential one: that is, at perihelion the apse progresses while at aphelion it regresses, but the progression is greater than the regression, so that on the whole the apse progresses. Now this disc action of the sun on Mercury is excessive because of (1) the enormous mass of the sun, (2) the close proximity to the planet, (3) the fact that the orbit nearly coincides with the equatorial plane of the sun, (4) the eccentricity of the orbit being very great, the difference between the aphelion and perihelion distances is extreme.

During the very close approach at perihelion, the progression is very great. The very slow rotation of the sun gives it an extremely slight spheroidicity—so slight that it cannot be measured. Careful measurements fail to show that the equatorial diameter is certainly a fraction of a second greater than the polar diameter. I regret that I cannot give here Professor Newcomb's discussion of this point in his "Astronomical Constants," but space forbids. We may, however, say that if the spheroidicity were so great as to be readily measurable, the progression of the apse would be extremely rapid—much more rapid than it actually is.

Now Professor Einstein in a letter to the *London Times* states that the excess of progression which Leverrier could not account for, "verifies" his theory and upsets Newton's gravitation. I am quoting his exact words.

Presumably he was not aware of the facts I have cited above, or, if so, cared less, for to a metaphysician celestial mechanics are of secondary importance. If theories can today be thus "verified," we have indeed come a long way from Newton, and have in fact bolshevized science.

F. J. B. Cordeiro.

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**The Transformation and Dissipation of Gravity.**—The conclusions of the mathematicians are based upon the erroneous premise that *momentum* is proportional to force, whereas *motion—molecular* as well as molar—is proportional to force.

An impressed force, of whatever kind, is not measured by the induced momentum, as the mathematicians postulate, but part of it is *transformed* into heat and radiated away. If two bodies of unequal masses are driven apart by an expenditure of force, such force will go into each body and take in each the form of *energy of translation* and *energy of heat*. The energy of translation of the less massive body will be greater than that of the more massive body. Hence when the heat generated by the impressed force has been dissipated, more force (i. e. energy of translation), will remain in the former than in the latter. Similarly where bodies move towards each other under the action of the forces which cause gravitation. *Heat is generated by the friction arising from elongation of the bodies.* The system will lose its energy of heat while retaining its energy of translation, until by collision it also is transformed into heat and radiated away. The error of the mathematicians consists in their "choice of premises", namely, in the assumption that the forces which cause bodies to gravitate towards each other are exhibited only in energy of translation, whereas they are exhibited also in energy of heat which is not conserved *to the system*. The increasing rate of acceleration of bodies as they move towards each other under the forces which cause gravitation, does not imply that the impressed forces are

not thereby being exhausted, but that *reinforcements* are being supplied as the bodies progress towards the central point of the system. The impressed forces increase in *density* inversely as the square of the distance. But they will all ultimately be transformed into energy of heat and be "dispensed with".

The theory upon which the mathematicians proceed is that the effect of a force varies inversely as the mass of a body upon which it is impressed, whereas in fact increasing the mass merely decreases the *energy of translation* and proportionately increases the *energy of heat* into which the force is transformed. The force is not *impaired* by the greater "inertia"; but part of it is thereby deflected and *transformed* into heat. There is no such thing as a *minus* quantity of force. The sum of two *opposed* forces is always greater than either of its components. To assert the contrary is to deny proportionality between *cause* and *effect.*

These considerations make it manifest, I submit, that the postulated "force" of the mathematicians does not correspond to the reality. The superstructure is unstable.

Of course these propositions are calculated to startle the student of *abstract* dynamics who treats force as *a rate of change of momentum,* but we are here dealing with problems of *concrete* dynamics which include the phenomenon of *heat* into which force is transformed.

Professor Tait ("Heat", Chap. III), speaking for the mathematicians, says that "force" is no more a "thing" than a "rate of interest" is "a sum of money"; but as, concededly, force *produces* momentum (and therefore heat and light) his statement is no less absurd than the statement that a rate of interest is a sum of money.

Equally unsound is his conception of the principle of dissipation of energy. There is no "tendency" in "nature" to "degrade" energy or to reduce it to a less "useful" form, as he asserts (p. 58). There is, as Lowell correctly says, a "tendency" *in the solar system* to "part with to space" its superfluous energy. Professor Tait radiates not light but darkness.

Herbert Spencer (*First Principles*; p. 169) and Dr. Croll ("On the Transformation of Gravity"; *Philosophical Magazine* for October, 1876) correctly contend that the force of gravity is transformed into energy, but they erroneously concede that the conception of force entertained by the mathematicians "suffices for physical inquiries" (Spencer), and "meets the mathematical and mechanical conditions of the problem" (Croll). As has been pointed out, the force of gravity is transformed into energy of heat and *radiated away from the solar system.* The doctrine of the "Persistence of Force" holds good not as to *each system* but only as to *all systems* in the Universe.

March 9, 1920. L. A. Redman.

## GENERAL NOTES.

**Dr. Heber D. Curtis,** Director of the Allegheny Observatory, will give the annual Sigma Xi lectures this year at the Universities of Missouri and Kansas.

**Dr. Edison Pettit,** since 1918 Assistant in Solar Physics in the Yerkes Observatory, has been appointed a member of the staff of the Mount Wilson Observatory. Dr. Pettit received the degree of Ph. D. this last summer at the University of Chicago (*Pub. Astr. Soc. Pac.* Oct. 1920).

**Professor Benjamin Boss and Dr. Ralph E. Wilson** of the Dudley Observatory, Albany, New York, have been making a series of tests of "seeing" conditions in Southern California, Arizona and New Mexico, during the past month for the Department of Meridian Astronomy of the Carnegie Institution of Washington. It is hoped that a satisfactory observing station may soon be established for determining by photographic methods, combined with meridian observations, the proper motions of large numbers of the fanter stars, selected upon such a systematic plan that the results may be used for statistical studies of the distribution of the stars and add to our knowledge of the structure of our universe.

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**A Meeting in Memory of the late Dr. Eric Doolittle,** Professor of Astronomy at the University of Pennsylvania, will be held in the auditorium of Houston Hall on the evening of November 12th. Addresses will be delivered by Professor Frank Schlesinger, President of the American Astronomical Society, the Rev. Dr. Robert Norwood and the Provost of the University. It is expected that the meeting will be largely attended by a great number of friends of Professor Doolittle.

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**Death of Mr. W. W. Dinwiddie,**—Mr. W. W. Dinwiddie died at West Orange, N. J., on October 6, 1920. For several years Mr. Dinwiddie was an assistant at the U. S. Naval Observatory, and he participated in the eclipse expeditions of 1900 at Griffin, Georgia, of 1901 at Solok, Sumatra, and of 1905 at Guelma, Algeria. He was particularly active in the preparation for the last mentioned eclipse, devising, designing, and in part constructing much of the apparatus to be employed at the different stations occupied by the Naval Observatory parties. He also made many observations with the 26-inch equatorial telescope.

After leaving the Naval Observatory, Mr. Dinwiddie was for a time with the Alvan Clark & Sons Corporation and more recently he has been for several years associated with the Thomas A. Edison Co. He was a man of untiring energy, an indefatigable worker, possessed of great ingenuity in devising new forms of apparatus and in making useful adaptations of old apparatus. He had a great affection for the science of astronomy and, although separated from active astronomical work, he still retained a keen interest in the science to which he had devoted his earlier years.

He is survived by his wife and three sons.

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**The Dedication of the Warner and Swasey Observatory** of the Case School of Applied Science, was held on October 12, 1920. The program of the exercises was as follows: Prayer, Professor George H. Johnson; Presentation addresses, Worcester R. Warner, and Ambrose Swasey; Acceptance for Trustees, President Charles S. Howe; Music; Address, "The Daily Influences of Astronomy", Dr. W. W. Campbell; Address, "The Aim of this Observatory," Professor D. T. Wilson; Music; Benediction. A more extended account of this occasion and a picture of the Observatory will be found in the earlier pages of this number.

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**The E. C. Pickering Fellowship for Women,** vacant by the death of Mrs. Fiammetta Wilson F. R. A. S., has been awarded to Miss A. Grace Cook,

F.R.A.S. It will be remembered that the Trustees decided some months ago to assign the Fellowship this year to an English woman. Miss Cook is also an ardent meteor observer and was a close friend of Mrs. Wilson; and it would have been difficult to suggest a more appropriate reversion under the tragic circumstances. The holder will carry with her all our good wishes for a prosperous year's work.—(*The Observatory*, October, 1920.)

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**The Laws Observatory,** which has stood on the campus of the University of Missouri since 1853, has been torn down. Plans for a new observatory have been made and a part of the building is now under construction on a favorable site about a half mile south of the original one.

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**Nova Cygni No. 3,**—This new star is no longer visible to the naked eye. It remained a naked eye star less than one month. A thorough study of the change in the spectrum of this star during the first ten days is given, with illustrations, by Professor Frost on page 531. A long list of estimates of brightness by the members of the American Association of Variable Star Observers is given on page 551.

The following notes by Felix de Roy taken from *The Observatory* for October, 1920, are of interest:

"The early history of Denning's nova is now pretty well known. Prof. Max Wolf confirms that previous to the outburst it must have been very faint. A plate taken at Heidelberg on 1905 June 3, and partly reproduced in *A. N.* 5062, shows stars of $16^m$ but no trace of the nova. The last photo of the region obtained there before the rise is a Tessar plate taken on 1920 July 20, when the new star was at least $<11^m$. A Franklin-Adams chart plate taken on 1908 Oct. 2 shows no trace of the nova, so that it must then have been below the 15th magnitude. On the Harvard plates (*H. B.* 729) it is $<9^m$ on 1920 Aug. 9, $4^m8$ on Aug. 19, $13^h20^m$ G. M. T. and $<3^m$ on three plates taken on Aug. 20. An important clue is given by a small plate taken by Nils Tamm at Kvistaberg, Bro, Sweden, on 1920 Aug. 16, $9^h25^m$ G. M. T., where the variable is shown as a $7^m4$ star. If the general rate of increase was of the order of somewhat more than $2^m$ in 3 days as between Aug. 16 and 19, it is possible to infer that even if the nova was originally of mag. 20 before the outbreak, this cannot have taken place earlier than the last days of July.

"Opinion as to the colour of the nova differs pretty widely. Some observations describe it as 'white,' or even 'blue,' but the most trustful seem to indicate that, even during the increase (from Aug. 22 onwards) and maximum the star *always* showed a distinctly yellowish tinge (at least $2^c.5$ on Osthoff's scale). Since the beginning of September, the colour has turned orange.

"It is remarkable that no less than four novæ., including Nova Aquilæ, No. 3, Nova Lyræ, and Nova Ophiuchi, No. 4, can still be observed at present with moderate apertures, and that, for a couple of years, novæ have been more plentiful than comets."

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**Variable Star Catalogue,**—The first volume of the "History and Literature of the Light Changes of the Stars Recognized as Variable up to the End of 1915, as well as a Catalog of the Elements of their Variations" was published in 1918 at the cost of the Astronomische Gesellschaft (Leipzig: Poeschel & Trepte). It is quite probable, however, that this important work has not as yet come to the notice of many of the observers of variable stars in this country. It is to be followed by two other volumes, one of which will be similar in char-

acter to the first and the other will be a catalogue of the newest elements of variation and "a number of important auxiliary tables." This enormous piece of work has been in preparation since 1901 and will constitute the most recent, and most nearly complete compilation of information concerning variable stars up to the present time. It has been edited by Professor G. Mueller and E. Hartwig, the two leading German specialists in stellar photometry. These volumes will surely be of great interest and value to all who have in any way made a study of variable stars.

The Astronomische Gesellschaft publishes also the quarterly *Vierteljahrsschrift*, and the (annual) *Jahresbericht*, chiefly bibliographical in character, covering in a very thorough manner the current astronomical literature. It has also issued (1890-1912) the great *A. G. Star Catalogues*, 19 volumes, covering the stars of the Bonn *Durchmusterung*, between declination +80° and —2°, extended to —18°; and twenty-four other quarto publications, of which No. 22 was the "Essay on the return of Halley's comet", by Cowell and Crommelin, 1910.

It is reported that owing to the difficult financial conditions, the Society will offer for sale its library, including a complete set of the *Astronomische Nachrichten*. This journal is recognized as of great significance in the development of astronomical science, and it is an unusual opportunity for a library or an observatory to secure this complete set, bound, at a very moderate cost.

Any American institution, by completing its sets of the above publications at the present time, will not only get some advantage from the current rate of exchange, but will at the same time assist the Sociey in its efforts to keep up its present publications.

Any one who may be interested in obtaining any of the publications mentioned above, or in learning more about them, is advised to write to Professor Elis Strömgren, Director of the Observatory, Copenhagen, Denmark, a member of the Council of the Society.

## Notes from the Yerkes Observatory

At the Convocation of the University of Chicago on September 3, the degree of Doctor of Philosophy was awarded to Alice Hall Farnsworth and to Edison Pettit, who have been doing graduate work at the Yerkes Observatory during recent years. Miss Farnsworth's thesis, which will appear in the *Publications of the Yerkes Observatory*, was entitled, "Comparison of the Photometric Fields of the 6-Inch Doublet, 24-Inch Reflector, and 40-Inch Refractor, with some Investigation of the Astrometric Field of the Reflector". The title of Mr. Pettit's thesis is, "The Forms and Motions of the Solar Prominences", and it will be published as Part 4 of Volume III of the *Publications of the Yerkes Observatory*. The examinations were held at the Observatory on August 13 and 14. Miss Farnsworth has been appointed Instructor in Astronomy at Mt. Holyoke, her alma mater. Mr. Pettit has received an appointment at the Mt. Wilson Observatory, and began his duties there on September 1.

Miss Frances Lowater, Assistant Professor of Physics at Wellesley, spent the summer, as Volunteer Research Assistant, in the study of stellar spectra.

Mr. John Paraskevopoulos, of the National Observatory, Athens, Greece, has been working on the spectroscopic binary 13 Ceti and his results appear in the September number of the *Astrophysical Journal*. He has devoted considerable time to 65 Tau Cygni, which was found to be a spectroscopic binary by Mr. Barrett in 1907. The quick changes in the velocity of this star made it necessary

to take a series of plates in immediate succession through the whole night. From the measurement of these plates, Dr. Paraskevopoulos found that the period was $0^d.1425$ or $3^h\ 25^m$. It therefore has the shortest period thus far found for any spectroscopic binary. His paper giving the orbit of this interesting star will be published in the *Astrophysical Journal*.

Mr. Maynard F. Jordan, Instructor at the University of Maine, spent the summer as graduate student.

The weather of the summer and autumn has been particularly favorable for observations, and nearly one hundred spectra of Nova Cygni have been obtained by Mr. Barrett with the Bruce spectrograph arranged with one prism. Mr. Parkhurst has obtained 137 spectra of the nova (up to Oct. 15), first with the Zeiss U.-V. camera and objective prism; later, with a reflector of 6 inches aperture and 60 inches focal length with the same objective-prism. When the star became faint, this reflector was attached to the 12-inch telescope, which served for guiding. With the use of the special red--sensitive plates, kindly furnished by Dr. Mees of the Eastman Kodak Company, it has been possible to get spectra which show the remarkable intensity of Hydrogen alpha ($H\alpha$) in the red, as well as the whole series of lines out beyond H and K.

Professor Barnard has a fine series of visual estimates of magnitude of Nova Cygni.

Señor Jaoquin Gallo, Director of the National Observatory of Mexico at Tacubaya, who worked at the observatory in the summer of 1904, made a brief visit in September.

On October 8 a solar prominence was observed by Mr. Lee, which reached the highest altitude thus far recorded with the spectroheliograph: 19′, or about 500,000 miles. The observations of the prominence covered the period from nine in the morning until two thirty in the afternoon, and 57 photographs were obtained.

On the Saturday afternoons during the summer, when the observatory was open to the public, there were 9,800 visitors. —F.

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**Erratum.**—We wish to call attention to an error on page 498 of the October (1920) issue, in connection with the constants given by Mr. Frank E. Seagrave for Borrelly's Comet (1905 II). The final letter in each case should be $u$, the argument of the latitude, instead of $v$, the true anomaly, as given. This error was made in reading proof and was not in the manuscript.